Region 1 Milkweed and Monarch Monitoring Geodatabase User Guide

Table of Contents

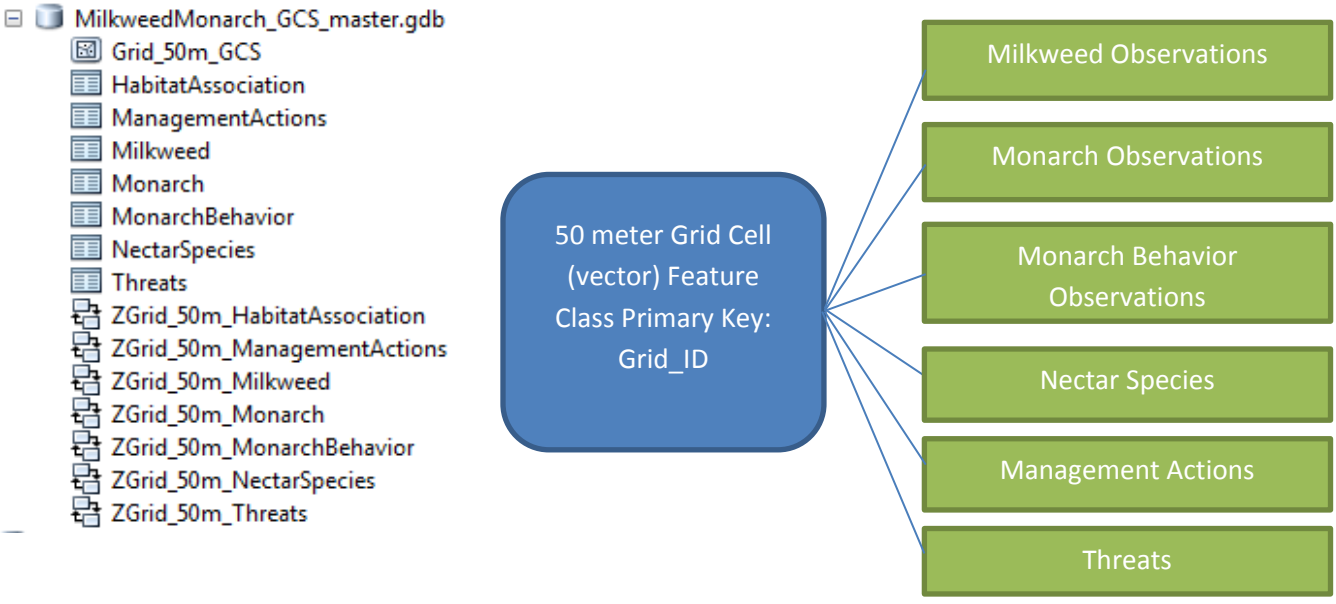
Introduction

The Region 1 Milkweed and Monarch Monitoring Geodatabase (MMG) was developed in 2016 to support a field data collection effort for baseline milkweed presence and monarch use in the Pacific Region. Twelve refuges supported by a team of four biotechs will collect milkweed distribution information along with a set of other habitat variables and habitat management measures. In addition presence and count information of Monarchs will be collected simultaneously.

The field teams will be equipped with Trimble Juno3B GPS units running ArcPad.

MMG is a relational geodatabase consisting of one vector (grid cell) feature class. The grid cell resolution is 50 meters. Linked to the feature class (to be referred to as the grid for the remaining document), are six relational tables; Milkweed, Monarch, Monarch Behavior, Nectar Species, Management Actions, and Threats.

By developing this as a relational model it is possible to repeat monitoring for a single cell over a long period of time in a tidy data model that will be readily available for analysis.



This document will describe the data model and provide a process for using this data model along with a custom designed ArcPad form (.apl) for field data collection.

Data Model Description

This geodatabase and procedure works best when running ArcGIS 10.3.1 and ArcPad 10.2. R3.

Computer must have ArcPad 10 or higher and Microsoft Mobile Device Center installed.

Each refuge is provided with a geodatabase that includes a gridded feature class covering their approved boundary. The grid cell size is 50 meter. Each refuge specific geodatabase is in the local UTM projection unless otherwise requested. Most refuges collect and manage their data in their local UTM projection, so to facilitate the use of this system with their already existing data (such as roads, management units, aerial imagery, etc.) the preferred projection is local UTM zone. For stations that prefer GCS, that can easily be provided. All data at the regional level (RO) will be managed in a GCS projection.

MMG_GCS_v1.gdb
MMG_UTM10_v1.gdb
MMG_UTM11_v1.gdb
MMG_UTM12_v1.gdb

The geodatabase empty shell (set to the preferred projection) is populated with a grid made using the FishNet tool in XTools. The Fishnet is generated in the local UTM zone. A Grid_ID is generated for each cell using the Refuge Literal_[Y Index][X Index]. The FishNet is then loaded into the Geodatabase. Detailed instructions for creating FishNet grids are not included in this UserGuide. Refer to ArcGIS help or XTools for instructions.

ArcGIS MXD

R1_Milkweed_LIT_v1.mxd

Layer files- symbology (ArcMap and ArcPad) are available for the feature classes included in the geodatabase.

Grid_50m.lyr - This layer file is set to color the grid cell depending on the presence or absence of Milkweed in the cell.

Grid_5k.lyr

SurveySites.lyr

SurveySites_Transects.lyr

FWSApproved.lyr

A custom layer file for the GPS unit's field forms is provided.

MilkweedMonarch_2016_Form.apl

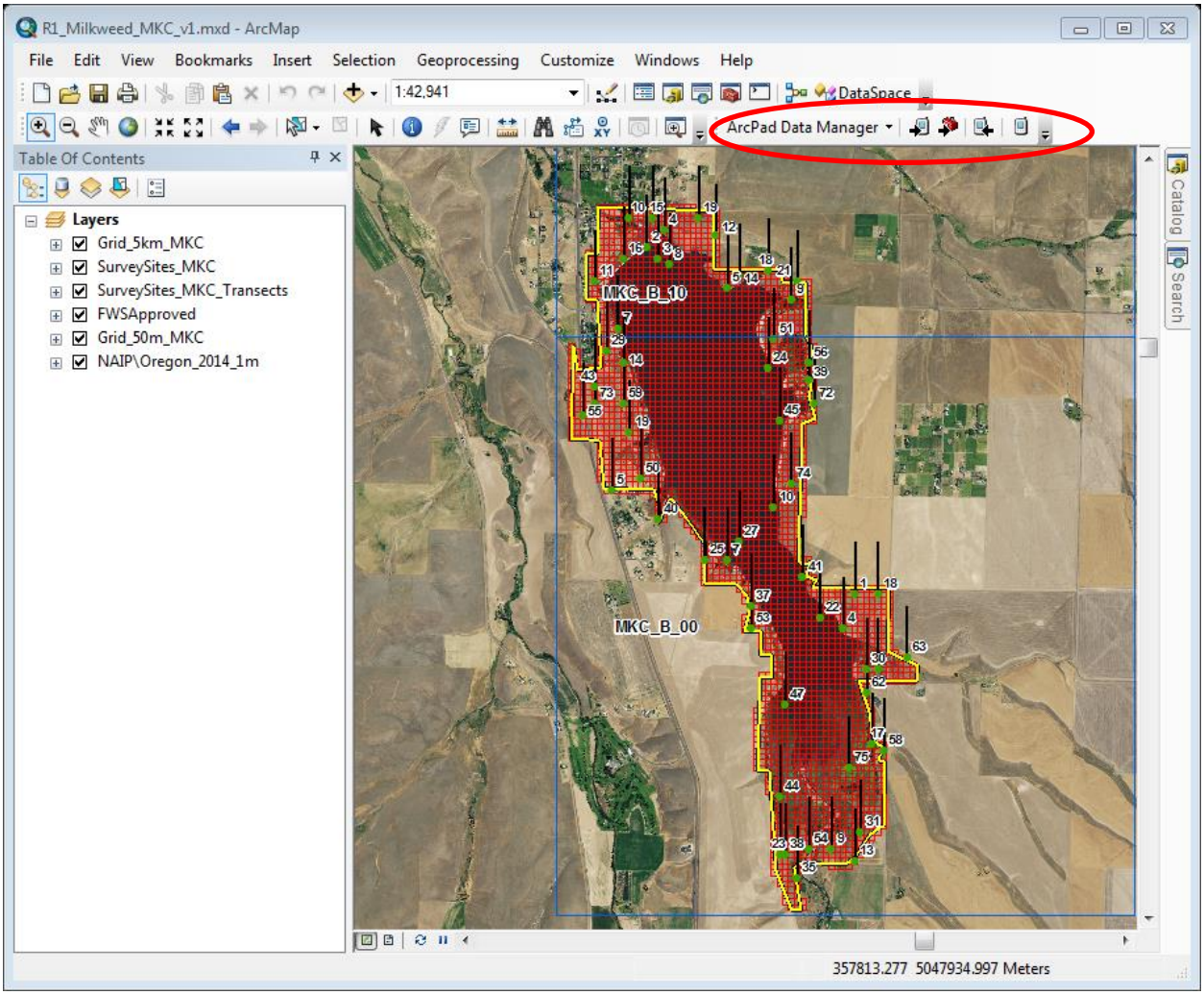
Procedures for Checking Out and Checking in ArcPad Layers for Field Data Collection

A preloaded MXD is provided to each refuge.

If no MXD is available, Start ArcGIS, add the data layer from *MMG_GCS_v1.gdb** > Grid_50m_GCS

*The exact name of the may vary. This name may be based on user preferences. The name of the geodatabase can be changed to suit the field station.

Zoom to your refuge, Save Map Document.



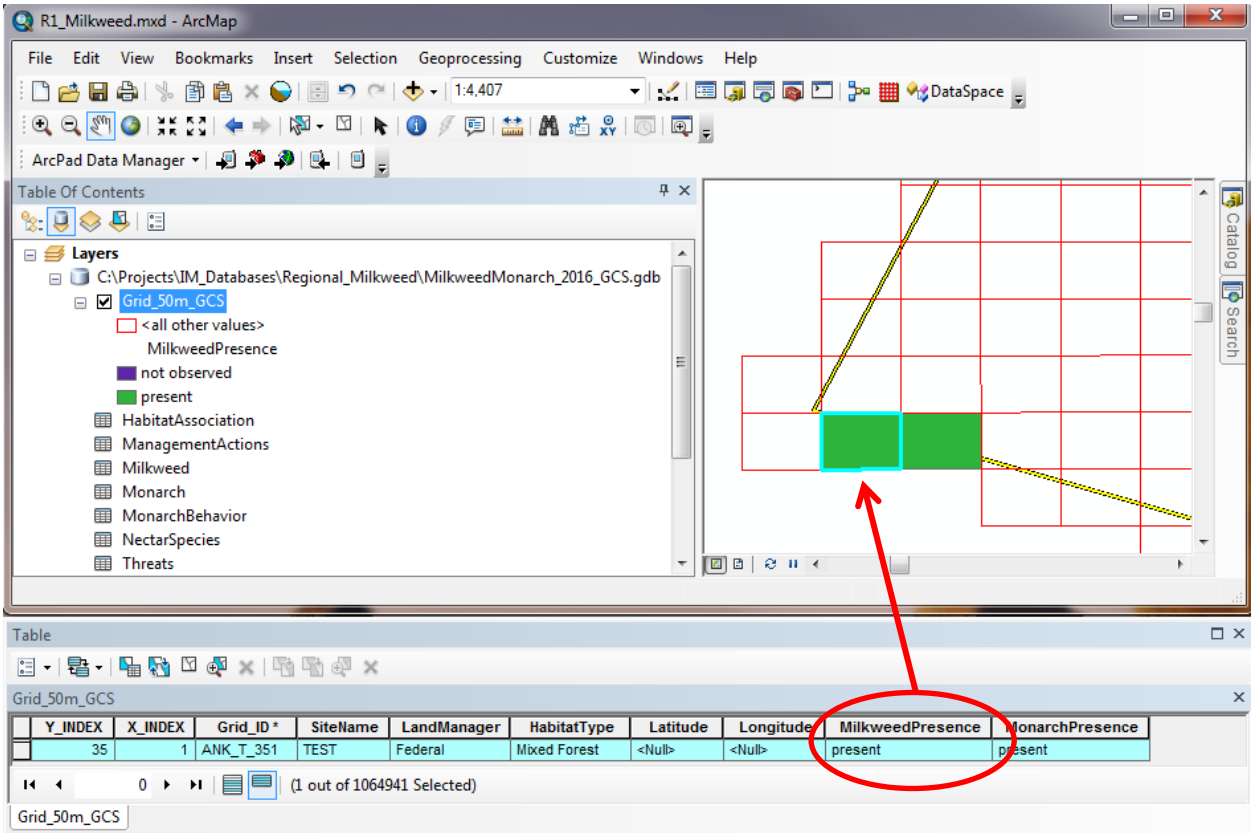
Ensure ArcPad tools are properly setup in ArcGIS. Go to Customize and turn on ArcPad Data Manager. Next, go to Toolbars and turn on ArcPad Data Manager.

If preferred, Use the Layer Properties>Symbology to set the layer properties. Layers are provided for the following feature classes.

Grid_50m.lyr

Grid_5k.lyr
SurveySites.lyr
SurveySites_Transects.lyr
FWSApproved.lyr

Import the symbology for each feature class. The Grid_50m layer file is set to turn a cell green when Milkweed is detected in the cell. As illustrated below:



Prepare files for check out to mobile device

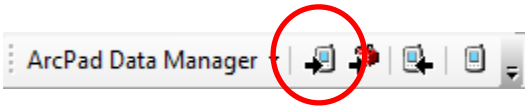
First set the viewer to the extent of the data you want to check-out. Smaller extent checkouts can be preferable if you intend to package up imagery to check out in your project or if you have a large refuge or survey area. It is recommended if you have a large survey area to break your checkout into smaller 'units'. Large extents will take longer to process and can slow down the GPS unit response times.

The recommended method is to perform a checkout based on the Block extent if you at a large refuge. For each Block 15 transects will be included. The goal is to conduct at least ten transects per Block, each transect with 10 plots (grid cells).

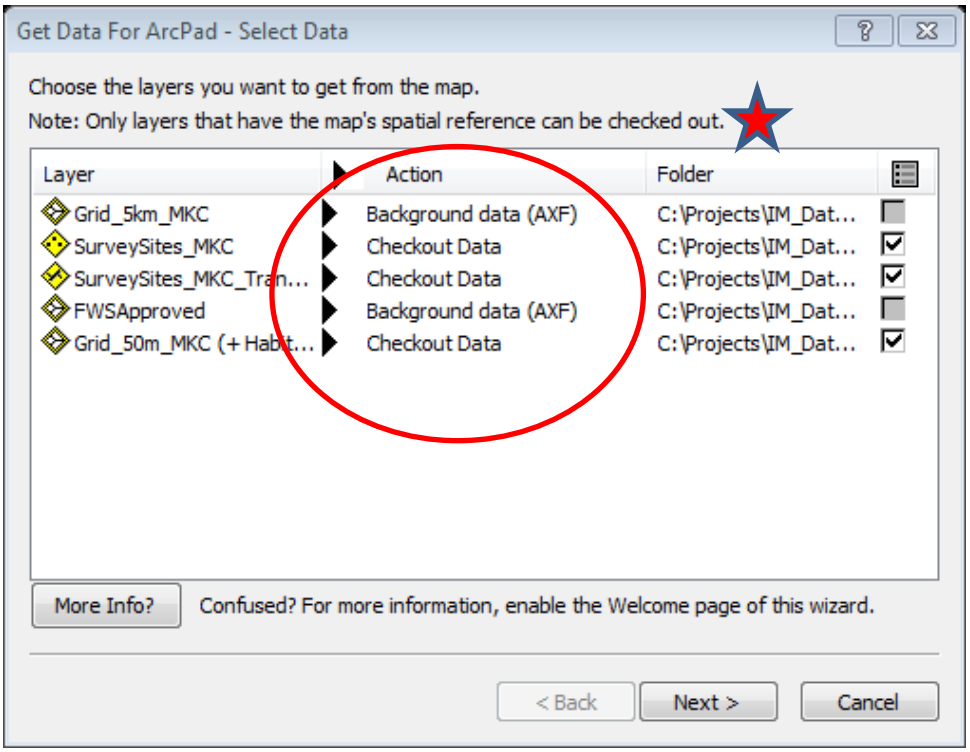
Preprocessing Block checkouts for field work can be a time saver, by doing this in advance you can be at the ready to visit any part of the refuge on short notice.

Go to the ArcPad Data Manager Toolbar

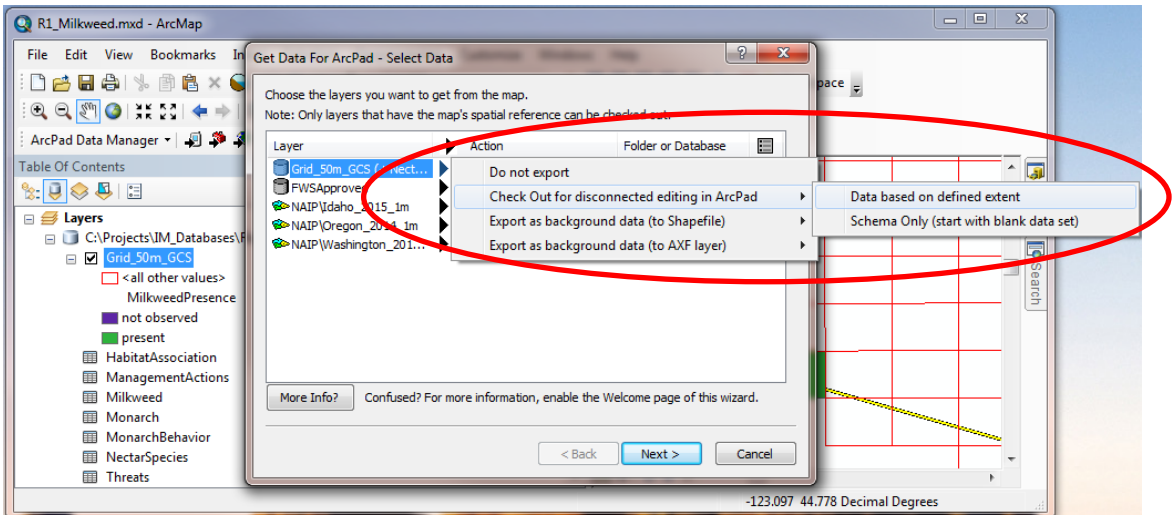
Click Get Data for ArcPad. Next to Welcome Screen (you can select the box to Not Show Again).



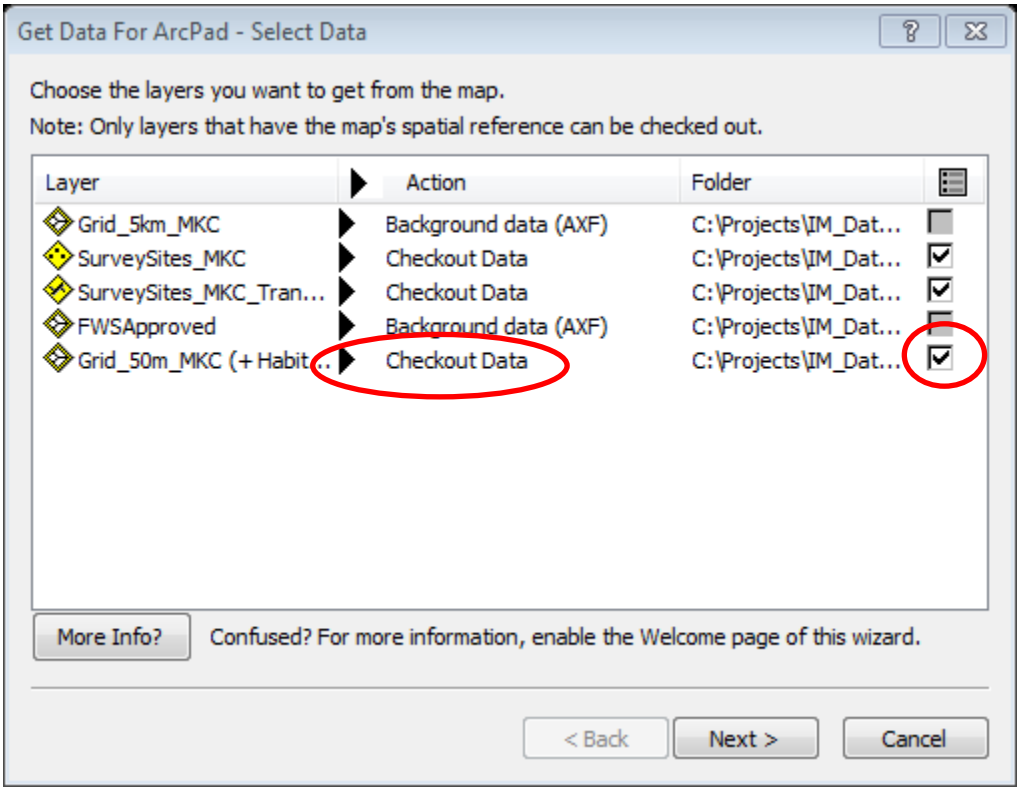
The Select Data screen will open. Update the Action column (right click) for each of the layers. Many Some layers can be checked out as background layers for navigation or other orientation purposes, but **they all must have the same projection as the milkweed grid feature class**. ArcPad cannot project on the fly. ArcPad provides very simple go to functionality for editable layers. Recommend Checkout Data for SurveySites, Transects, and the 50m Grid.



But we will be updating the Grid_50m_LIT file. Update the Action for the grid layer, Check Out for disconnected editing in ArcPad > Data based on defined extent. The defined extent is that extent shown in the map viewer/data frame window.



Next, check the check box at the end of the row to use the custom form called **MilkweedMonarch_2016_Form.apl**



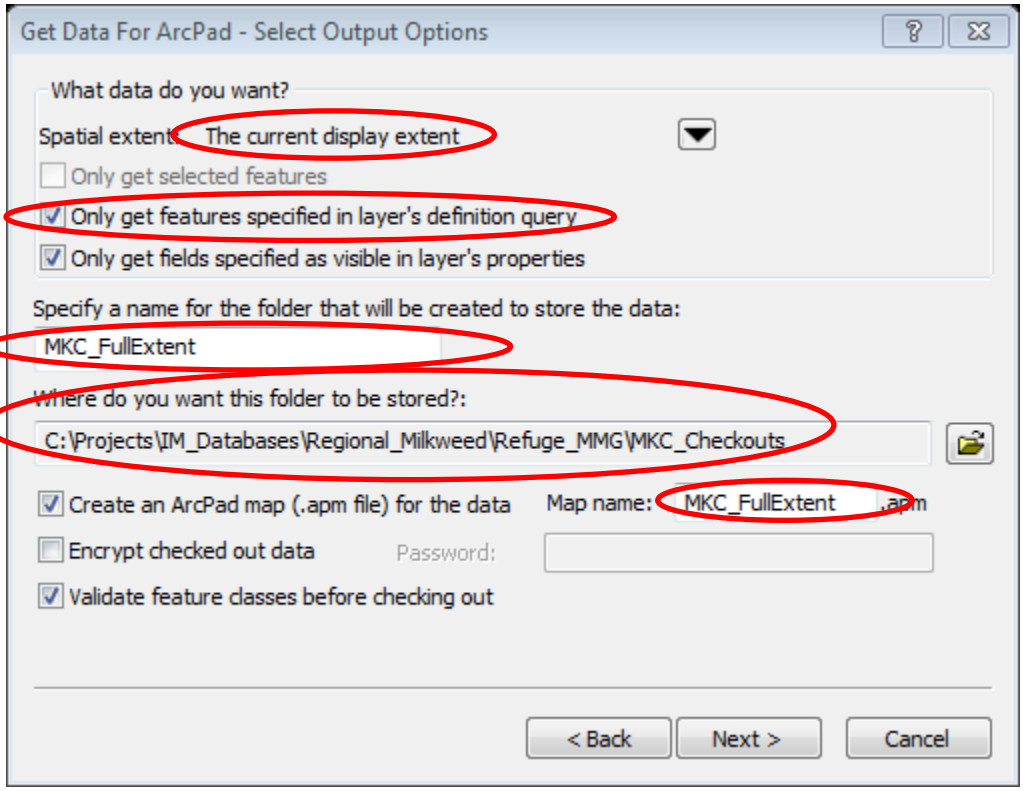
Checking the box will display the Open Layer 'explorer'.

Navigate to the location of **the MilkweedMonarch_2016_Form.apl** and click Open.

Click Next to Select the Picture Options. These are not currently being used in the data model, Click Next.

Click Next to Select the Output Options.

Use the current display extent to focus your data collection on the area to be surveyed using this checkout. It is recommended to only check out as large an extent as needed. Use of predefined bookmarks and survey target extents is recommended.

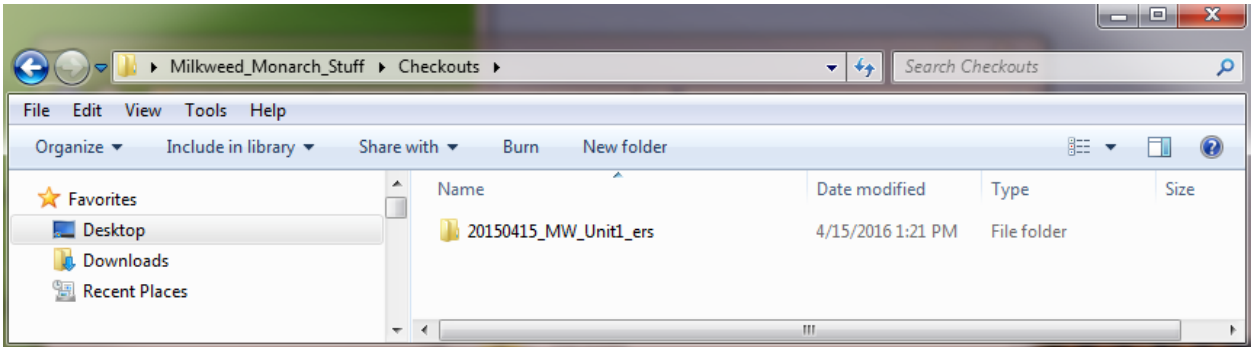


Create a folder to store the data. Set where you want to store the data. It is best to set-up a directory for this specifically. For example, 'MKC_Checkouts'.

When the data from ArcMap is checked out a folder will be created to hold the checkout.

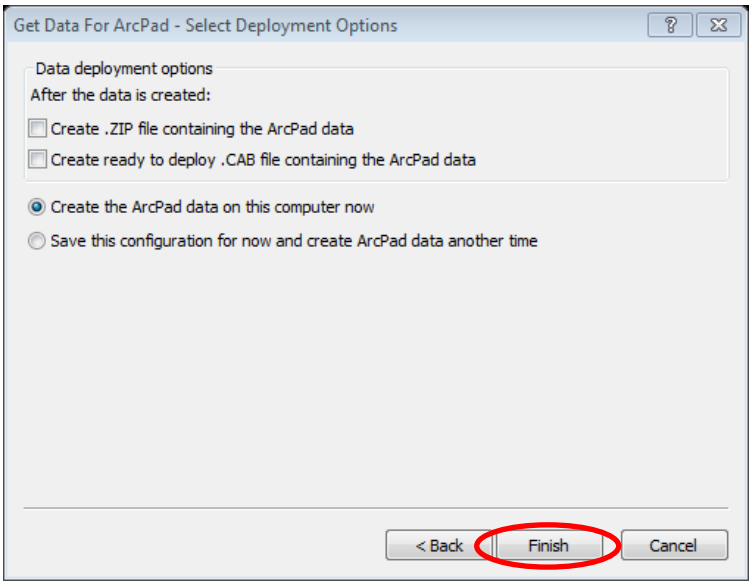
Tip: Name this folder will descriptive elements such as When_What_Where_Who. An example might be '20150531_MKC_Unit1_ers'.

Tip: Notice the date format, it is the best format for organizing your files according to date.



Lastly, give the map that will be opened in ArcMap a name. An easy way to keep it all straight is to use the folder name, you can just copy and paste. Click Next.

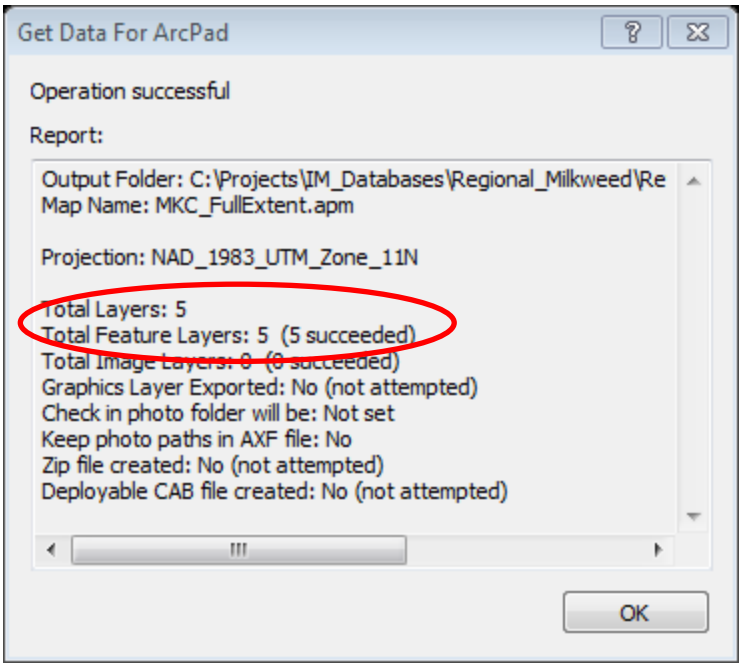
Leave all the other settings with the defaults on the Deployment Options screen.



Click Finish.

This could take some time depending on the extent of the checkout. Be patient!

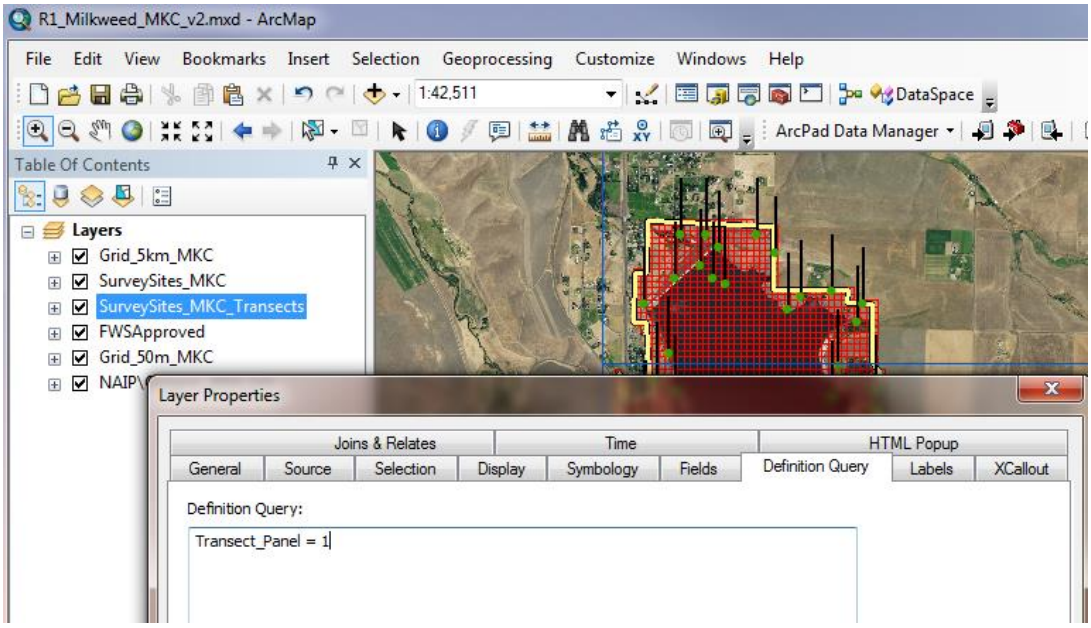
You ought to receive a message. Review to make sure the number of feature layers matches what you would expect.



Click OK to close dialog box.

Tip: The symbology that is set in the current ArcMap document will be used in ArcPad.

Tip: Definition queries are a nice way to limit the data you take into the field. For example, the sample frame (grid layer) is coded with up to 5 panels, each of these panels have 15 sample sites. You can limit the checkout procedure to only checkout a specific panel.

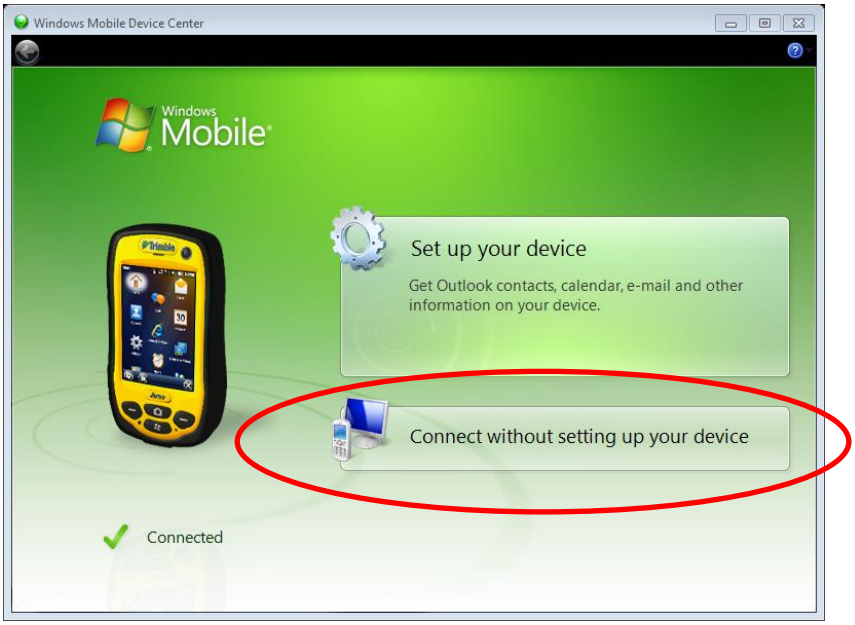


Load the data to the GPS Unit

Open Microsoft Mobile Device Manager

Plug your Trimble into the computer using the USB cord.

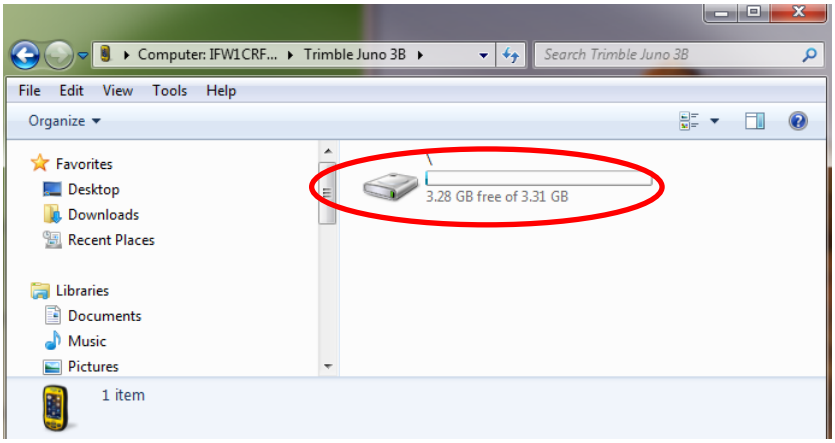
You will see a couple messages on the GPS indicating it is communicating and Microsoft Mobile Device Center should eventually indicate Connected. Connect without setting up your device.



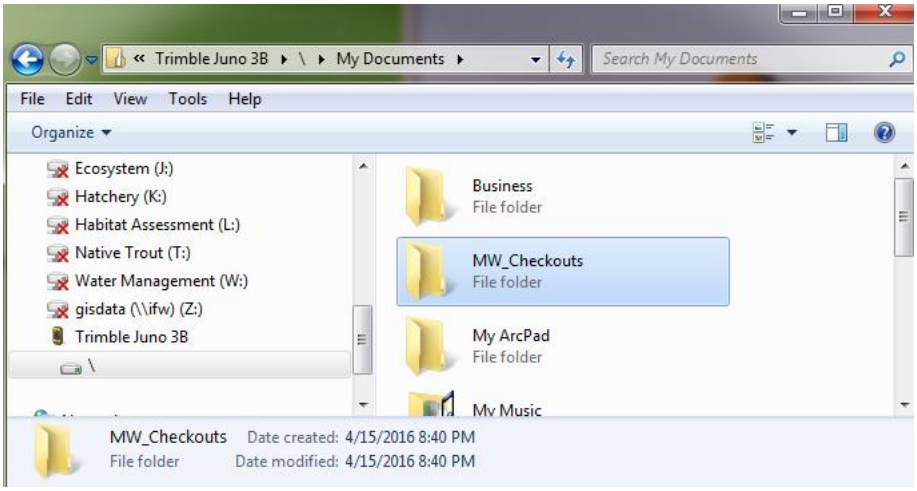
Go to Connect without setting up your device, click.

Go to File Management. Browse the contents of your mobile device.

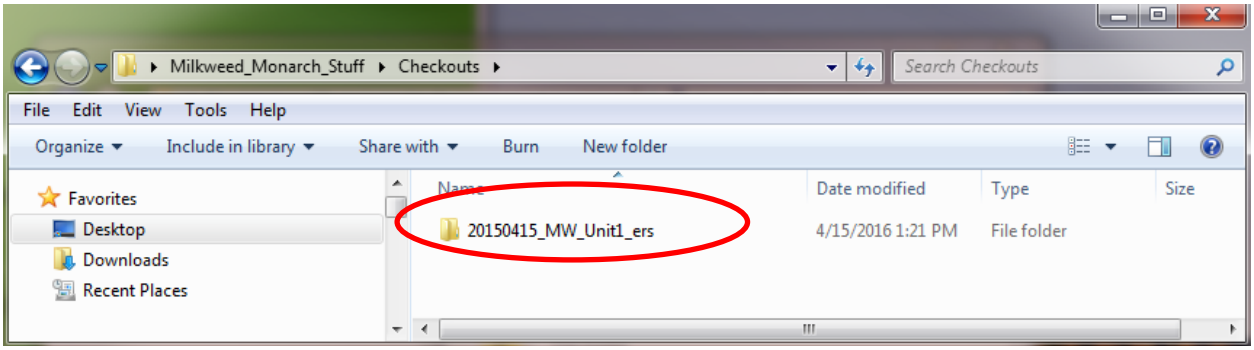
That will bring up an explorer window with your device showing. Double click on the drive.



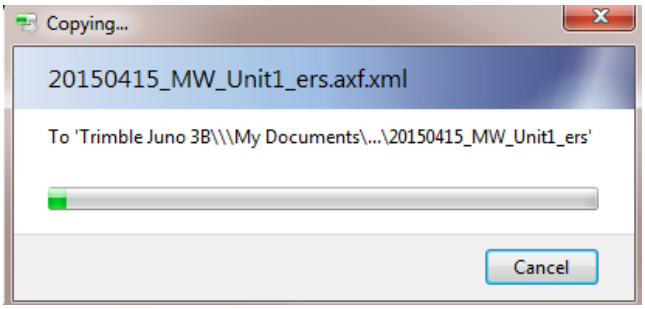
Go to My Documents and create a folder for the project on the Trimble unit. In the example below the folder is named 'MW_Checkouts'. This folder will be used to store all your checkouts.



Now, go back to the location where you saved your ArcPad data and Copy the entire folder of prepared files.



Return to the Trimble folder (set up in the previous step). And paste into the working directory folder. By copying this folder over, you have moved a copy to the GPS which will be used in the field (edits and new data collection).

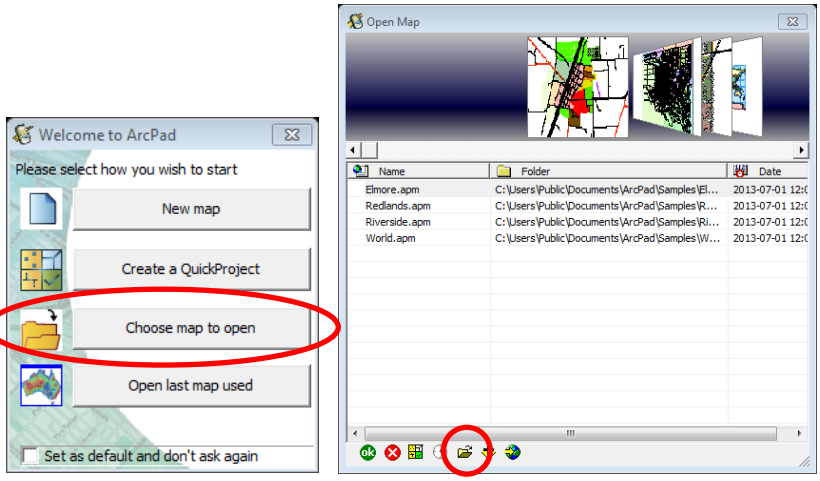


It is always good practice to open the map on the unit and take a test point before heading out to the field. You want to make sure everything loaded properly before you are out in the middle of nowhere!

If more than one field crew or field tech is going to collect data, do a separate checkout for each and name the folders accordingly.

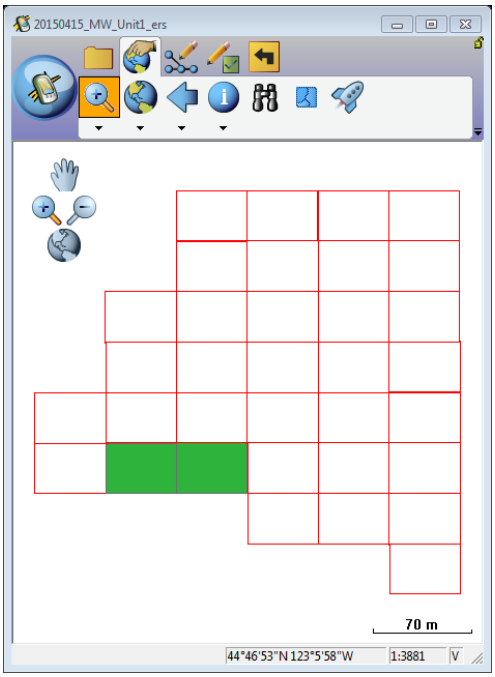
ArcPad Instructions

Go to the GPS unit, Click the ArcPad icon and Choose map to open.



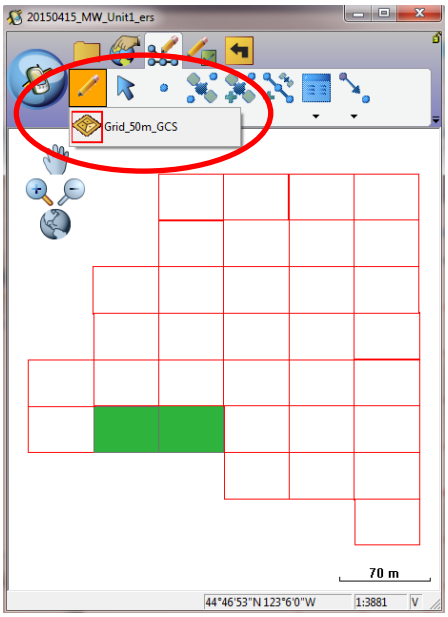
Navigate to the folder where the .apm (ArcPad map document) is stored. Open folder select the .apm file. Select the .apm and click Open.

Once the map opens zoom into a scale you can clearly see the grid.



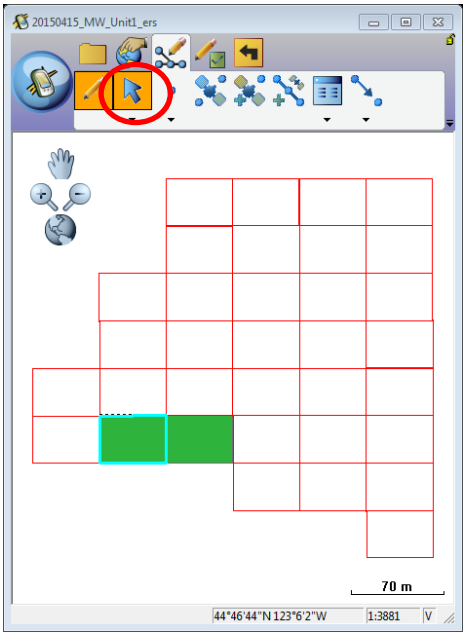
If you are connected to satellites you can alternatively set the GPS to Center on GPS. This will put the crosshairs in the middle of the screen and show you your position. When walking a red arrow like feature will point in the direction you are moving. This red arrow feature disappears when standing still.

When it is time to collect attributes, turn on editing for the grid layer. Notice the red box around the icon, that red box indicates it is editable.

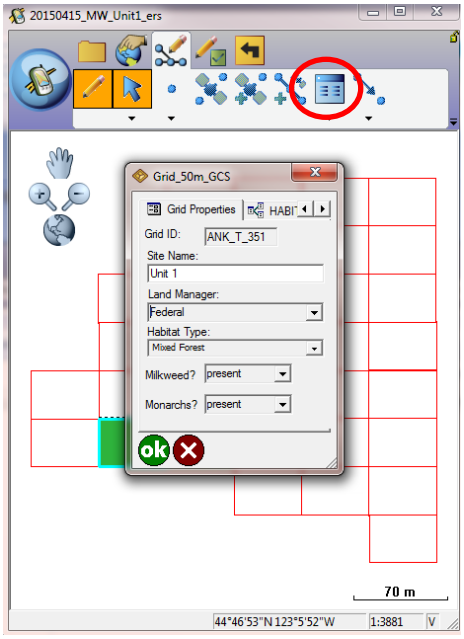


Practice taking a point using GPS capture and taking a point using the select tool.

Now turn on the grid layer for editing. To select a cell, select the blue arrow and click on a cell, OR use Select at GPS Position (if you are standing in the segment).



Click the Feature Properties (attributes) button is clicked the custom form should appear.



If you do not see the above form you did not check out the data using the custom form. Redo the process to ensure you have full functionality during your data collection.

All Form Properties

The following sections describe the requested data fields in each geodatabase form. **The highlighted fields are required**, the rest are optional but please fill them out if you have the opportunity.

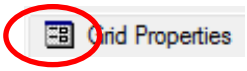
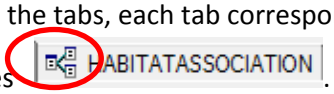
Not all of these forms need to be filled out while in the field. The underlined form names with an asterisks need to be filled out in the field, the rest can be done in the office.

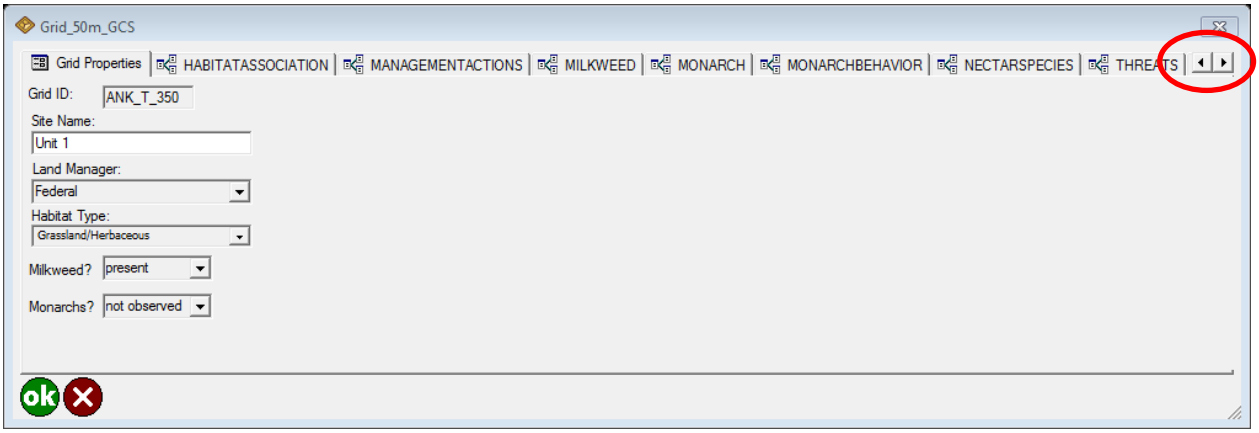
This geodatabase is relational. The Grid Properties is the primary feature class, it represents a layer made up of cells. Each cell is related to six tables. The relationship between the feature class and the related tables is one:many. Meaning, for each grid cell there can be many records associated in each of the tables. Multiple records (or attributes) are captured by filling out the respective form, selecting the blue arrow to get back to the main form page, and then selecting the add data button again (blue circle with white plus sign). Repeat this work flow as many times as you need to enter all appropriate attributes.

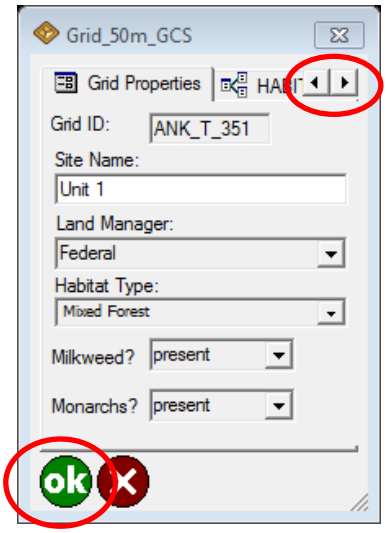
Grid Properties Form*

This form is directly tied to the grid Feature Class.

Use the arrows to move between the tabs in order to enter data in the various relational tables. Each table has its own tab.

The graphic below is expanded to show all the tabs, each tab corresponds to the feature class  and the relational tables  .





Work through as many of the tabs as necessary, and then click the green OK button.

The green OK button completes the record (a feature class record and related table records), and closes the forms.

Do not click the green OK button until you have completed the Grid Properties and the Related Table tabs, as needed.

Grid ID: Automatically generated. Do not edit.

Site Name: Enter more detailed site name here, i.e. the specific Refuge unit.

Land Manager: City/Town, County, Federal, NGO, Private, State, Unknown. (choose one)

Habitat Type: General habitat type that the milkweed occurs in – See **Table 1.0** (multi-select)

Milkweed: Present or Not Observed. (choose one). This field is used to indicate the Presence or Absence of an observation at the site over time. A field season specific observation (presence or absence) is located on the Milkweed tab.

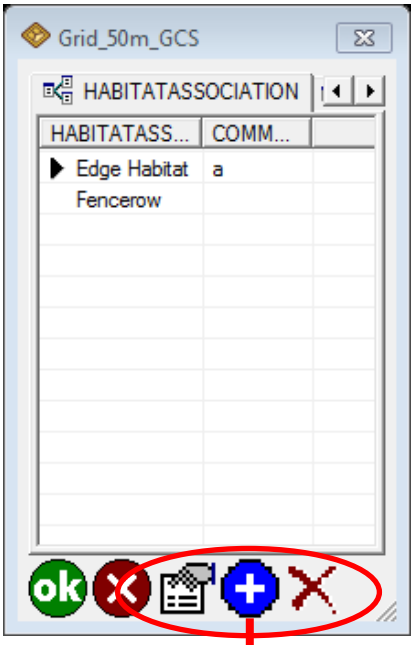
Monarchs: Present or Not Observed. (choose one). This field is used to indicate the Presence or Absence of an observation at the site over time. A field season specific observation (presence or absence) is located on the Monarch tab.

Habitat Association Form*

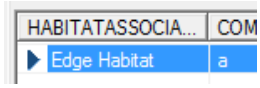
This form is used to report general habitat information at the observation site.

Habitat Association: Habitat parameters that more effectively describe the milkweed stand location – See **Table 2** for list of choices and definitions. (relational table, multiple records may be entered for a single cell)

When the tab is selected the attribute table is displayed showing all records for the selected feature (grid cell).



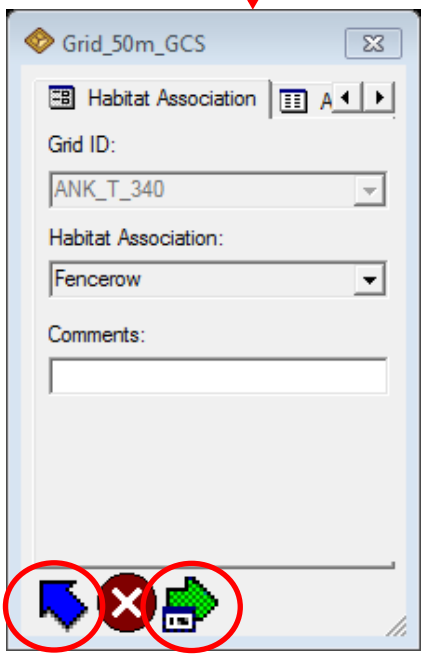
Attribute Table view

Clicking on a record in the attribute table will select it and a record marker will show to the far left of the record and it may be highlighted 

The show attributes button  can be used to review the record in form view, or a scrollbar can be used to scroll across and review the attributes.

Click the blue plus sign button  to open the form and enter data.

The red X  will delete the selected record in the attribute table



Data Entry Form

Click the blue arrow button  after updating the data fields to close the form and return to the attribute table.

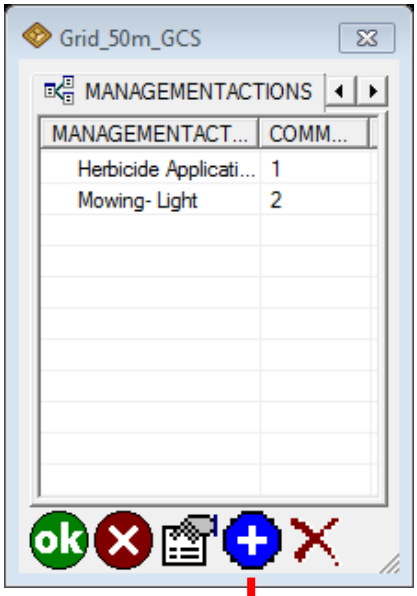
The green arrow is useful if you will be repeating an attribute, such as Observer or Habitat Association. This will save the value for the next record, and use it as a temporary default.

To turn this on, fill in the attributes you will want repeated and click the green arrow. It will then become highlighted  . The default setting can be deactivated on any subsequent new record by reclicking the green arrow, this will remove the highlighting.

Management Actions Form

This form is used to report known land management or other actions that occur on the site that may affect (positively or negatively) the milkweed plants.

Management Actions: Land management actions that may affect the milkweed at the observation site. See **Table 3** for list of choices and definitions. Relational table, multiple records may be entered for a single cell).When the tab is selected the attribute table is displayed showing all records for the selected feature (grid cell).



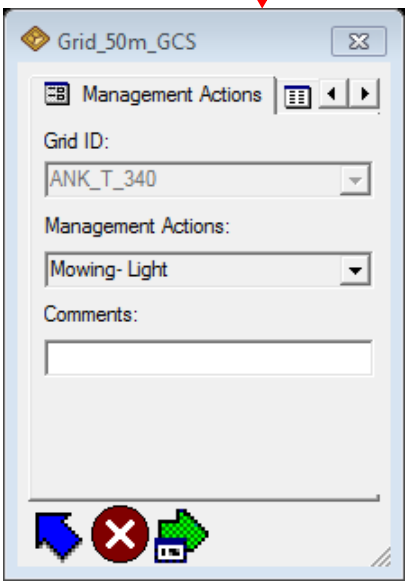
Attribute Table view

Clicking on a record in the attribute table will select it and a record marker will show to the far left of the record and it may be highlighted .

The show attributes button  can be used to review the record in form view, or a scrollbar can be used to scroll across and review the attributes.

Click the blue plus sign button  to open the form and enter data.

The red X  will delete the selected record in the attribute table.



Data Entry Form

Click the blue arrow button  after updating the data fields to close the form and return to the attribute table.

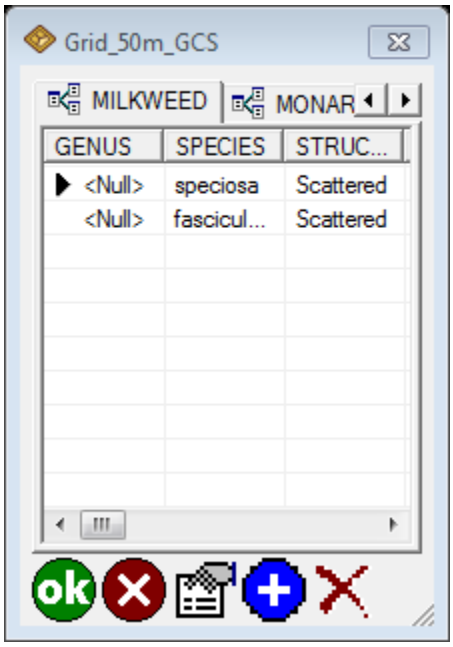
The green arrow is useful if you will be repeating an attribute, such as Observer or Habitat Association. This will save the value for the next record, and use it as a temporary default.

To turn this on, fill in the attributes you will want repeated and click the green arrow. It will then become highlighted  . The default setting can be deactivated on any subsequent new record by reclicking the green arrow, this will remove the highlighting.

Milkweed*

This form is used to report milkweed information at the observation site.

Relational table, multiple records may be entered for a single cell. When the tab is selected the attribute table is displayed showing all records for the selected feature (grid cell).



Attribute Table view

Clicking on a record in the attribute table will select it and a record marker will show to the far left of the record and it may be highlighted .

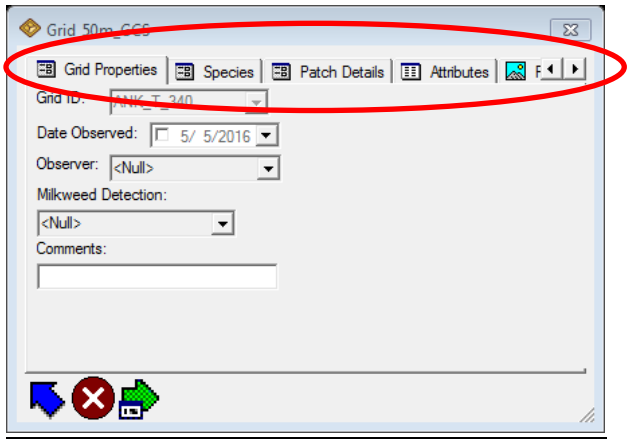
The show attributes button  can be used to review the record in form view, or a scrollbar can be used to scroll across and review the attributes.

Click the blue plus sign button  to open the form(s) and enter data.

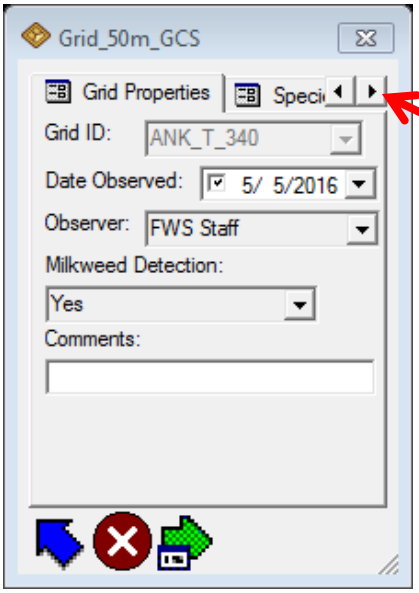
The red X  will delete the selected record in the attribute table.

The Milkweed Tab has a series of subforms (tabs), when the add new record is activated the user will see a series of tabs related strictly to the Milkweed Observation. These subforms (tabs) are the; Grid Properties, Species, Patch Details.

Cycle through all three tabs before using the blue arrow  to return (and save) the new record.



GRID PROPERITES TAB:



Reminder:

Cycle through all three tabs before using the blue arrow to return (and save) the new record.

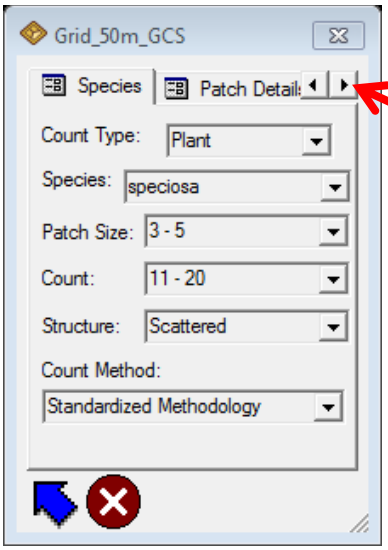
Date: Date of observation.

Observer: Other Agency, CitizenScientist, FWS Volunteer, FWS Staff, FWS Biotech. (choose one)

Milkweed Detection: Yes or No. (choose one). This is a day/time specific detection of Milkweed in this grid cell.

Comments: Enter any additional comments regarding the milkweed patch (if observed) such as condition of plants or observed pests.

SPECIES TAB:



Reminder:

Cycle through all three tabs before using the blue arrow to return (and save) the new record.

Count Type: Indicate whether the count is of stems (clonal) or plants. Some milkweed species are clonal and produce single stems without above-ground branching, such as A. speciosa – plant or stem. See **Table 4**. (choose one)

Species: Enter milkweed species observed at survey site. If there are multiple species present, record each of these like you would for a multi-select entry. See **Table 5** for full list of species and subspecies.

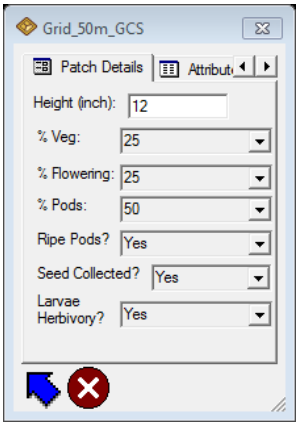
Patch Size: Patch size of milkweed delineated by GPS coordinates, reported in square meters (length x with) 1 meter = 3 feet. <1, 1-3, 3-5, 5-7, 7-10, 10-15, 15-20, 20-30, 30-50, 50-100, 100-200, >200. (choose one)

Count: Complete count or estimated number of plants (or stems) in the patch designated by the GPS Coordinates. 1-5, 6-10, 11-20, 21-50, 51-75, 76-100,101-500, 501-1000, 1001-1500, 1501-2000, 2000+. (choose one)

Structure: The spatial arrangement of the milkweed plants within the landscape. Milkweed population occurrence at the site – scattered, clumped, linear. See **table 6** for data definitions. (choose one)

Count Method: Enter how you derived your plant count and percentages for the stages of phenology – vegetative, flowering, pods. See **Table 7** for data definitions. (choose one)

PATCH DETAILS TAB:



Height (inches): Average height of plants in the patch – report in inches.

% Veg: Record the percent of plants in a vegetative state without buds, flowers, or pods – 0%, 25%, 50%, 75%, 100% (choose one)

% Flowering: Record the percent of plants with buds and/or open flowers – 0%, 25%, 50%, 75%, 100% (choose one)

% Pods: Record the percent of plants with pods (includes young to mature pods) – 0%, 25%, 50%, 75%, 100% (choose one)

Ripe Pods? : This field is intended to document approximate dates of seed dispersal to facilitate future seed collections. Pods are brown, splitting, or dispersing seed. Yes or No (choose one)

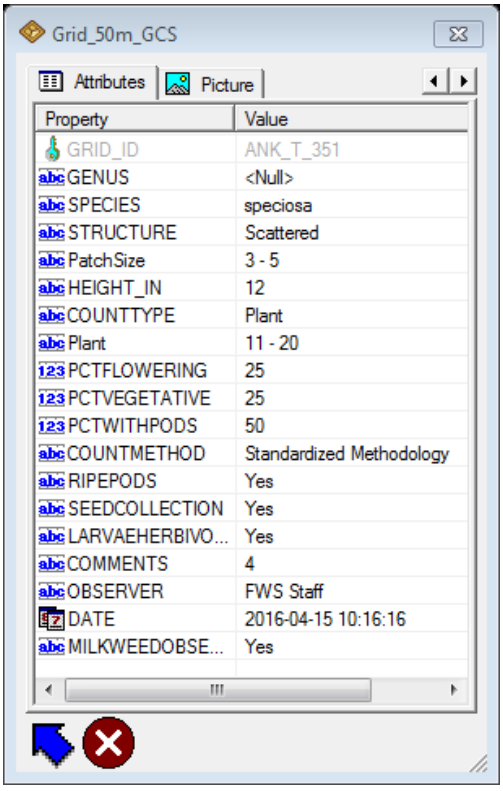
Seed Collection? : This field is to document that ripe milkweed seed was collected from this location. Yes or No (choose one)

Larvae Herbivory: Plants show evidence of herbivory from caterpillars. Choose One: Yes, No, or Not Checked

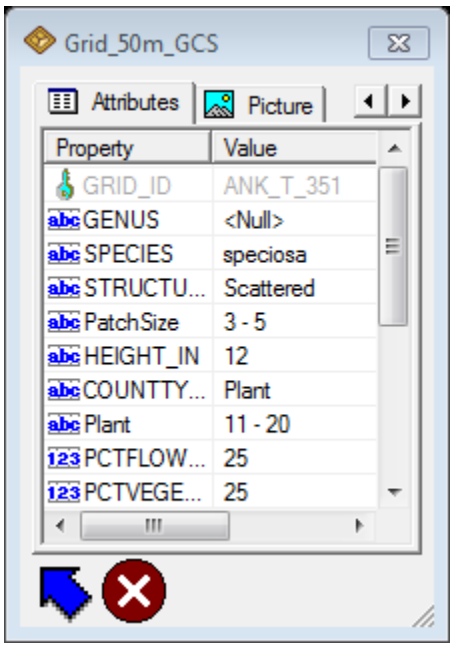
TIP: Alternate Workflow for Milkweed Tab

An alternate workflow for collecting the Milkweed attributes is to scroll over to the Attributes tab. The Attributes tab lists every field in the forms described above and can be used for data entry. The example below has been expanded to show the entire attribute table. In general only a small portion can be viewed on handheld devices so more scrolling may be required.

Expanded view



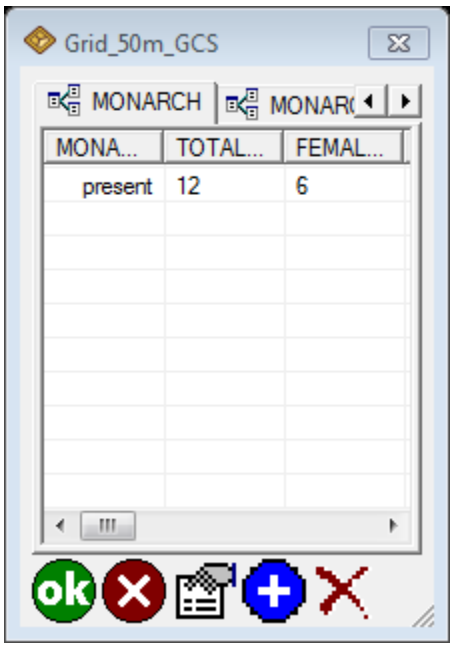
Typical view on a handheld device



Monarch Form*

This form is used to report monarch information at observation site.

Relational table, multiple records may be entered for a single cell. When the tab is selected the attribute table is displayed showing all records for the selected feature (grid cell).



Attribute Table view

Clicking on a record in the attribute table will select it and a record marker will show to the far left of the record and it may be highlighted .

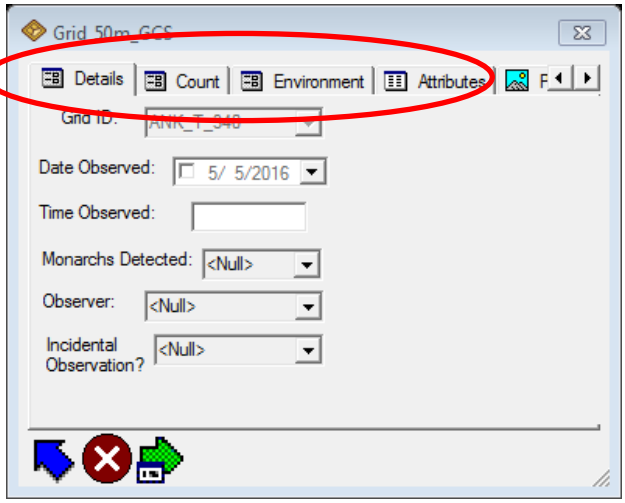
The show attributes button  can be used to review the record in form view, or a scrollbar can be used to scroll across and review the attributes.

Click the blue plus sign button  to open the form(s) and enter data.

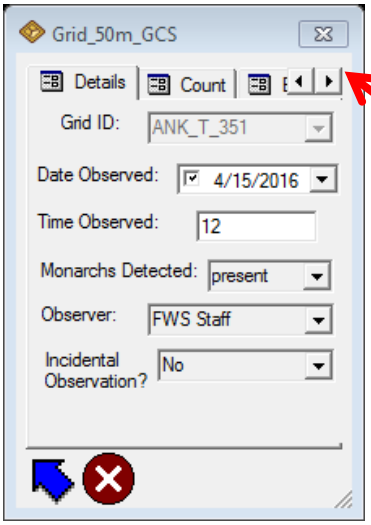
The red X  will delete the selected record in the attribute table

The Monarch Tab has a series of subforms (tabs), when the add new record is activated the user will see a series of tabs related strictly to the Monarch Observation. These subforms (tabs) are the; Details, Count, Environment.

Cycle through all three tabs before using the blue arrow  to return (and save) the new record.



DETAILS TAB:



Reminder:

Cycle through all three tabs before using the blue arrow to return (and save) the new record.

Date Observed: Date of observation.

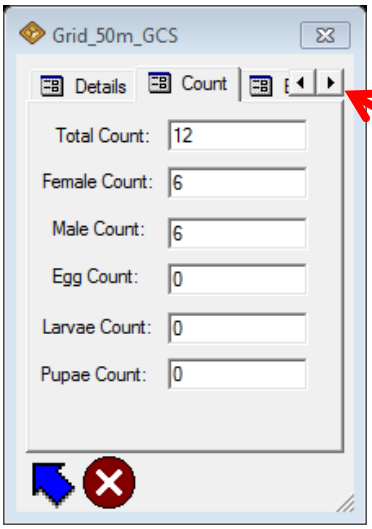
Time Observed: Enter time of observation using 24 hour clock (military time).

Monarchs Detected: Were monarchs observed at this site? Present or Not Observed (choose one).

Observer: Other Agency, CitizenScientist, FWS Volunteer, FWS Staff, FWS Biotech (choose one).

Incidental Observation?: If monarchs were observed, was the sighting incidental? Yes or No (choose one).

COUNT TAB:



Reminder:

Cycle through all three tabs before using the blue arrow to return (and save) the new record.

Total Count: Total number of adult monarchs observed. If none were observed put a 0 in this cell.

Female Count: # of adult female monarchs observed at the site.

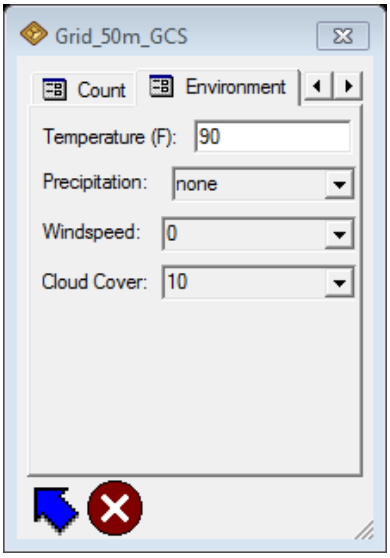
Male Count: # of male monarchs observed at the site.

Egg Count: Number of monarch eggs observed.

Larvae Count: Number of monarch larvae observed.

Pupae Count: Number of monarch pupae observed.

ENVIRONMENT TAB:



Temperature (F): Enter temperature in Fahrenheit at time of sighting, if known.

Precipitation: Enter any precipitation at time of sighting. None, Trace, Light, Moderate, Heavy (choose one)

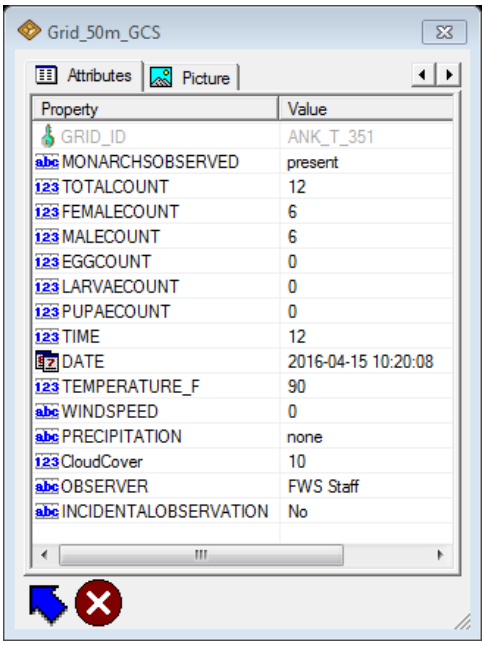
Wind Speed: Enter approximate wind speed range (in MPH) at time of sighting, if known. <1, 1-3, 4-6,7-10, 11-16, 17-21, 22-27, >27. (choose one)

Cloud Cover: Enter range of cloud cover at time of sighting. 0,10,20,30,40,50,60,70,80,90,100. (choose one)

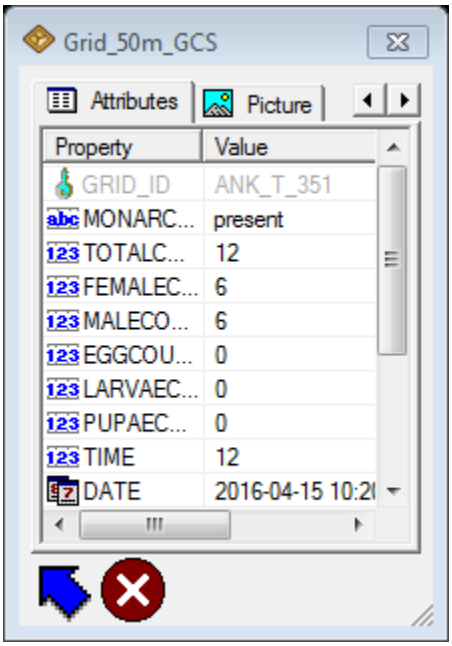
TIP: Alternate Workflow for Monarch Tab

An alternate workflow for collecting the Monarch attributes is to scroll over to the Attributes tab. The Attributes tab lists every field in the forms described above and can be used for data entry. The example below has been expanded to show the entire attribute table. In general only a small portion can be viewed on handheld devices so more scrolling may be required.

Expanded view



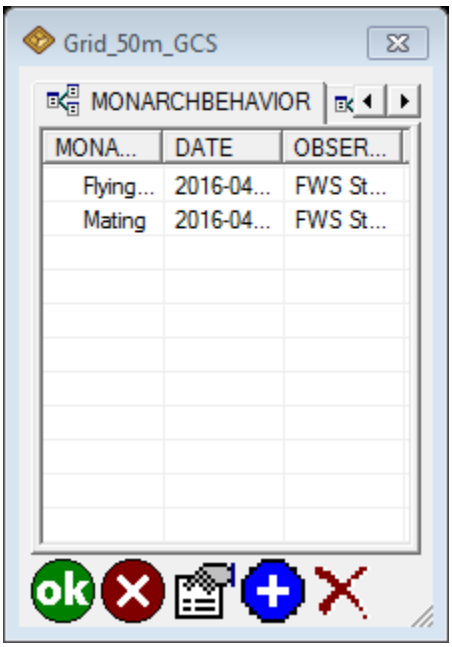
Typical view on a handheld device

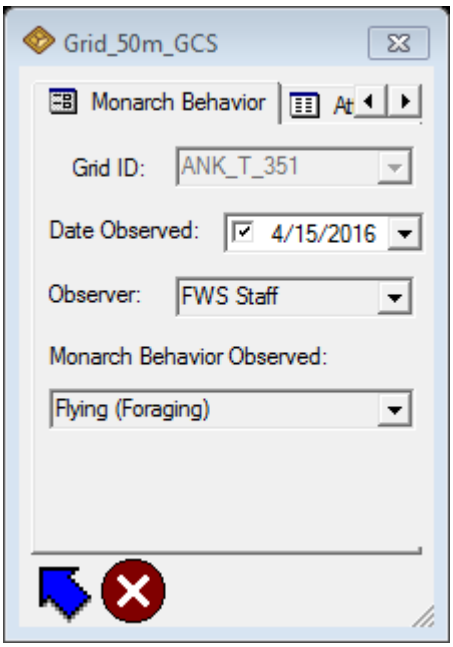


Monarch Behavior Form*

This form is used to report monarch behavior observed at the survey site.

Relational table, multiple records may be entered for a single cell. When the tab is selected the attribute table is displayed showing all records for the selected feature (grid cell).





Date Observed: Date of observation.

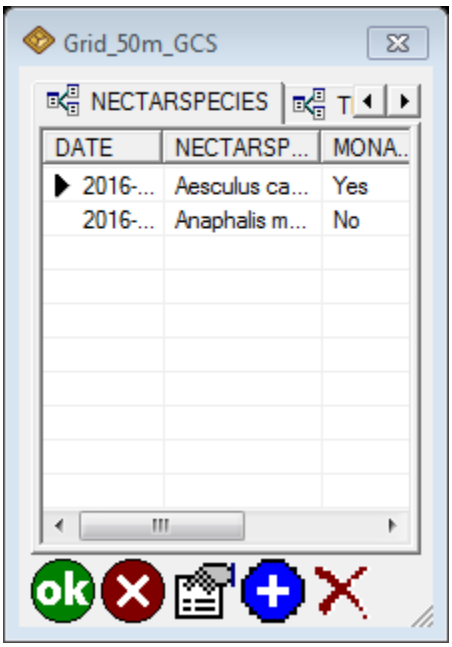
Observer: Other Agency, CitizenScientist, FWS Volunteer, FWS Staff, FWS Biotech (choose one).

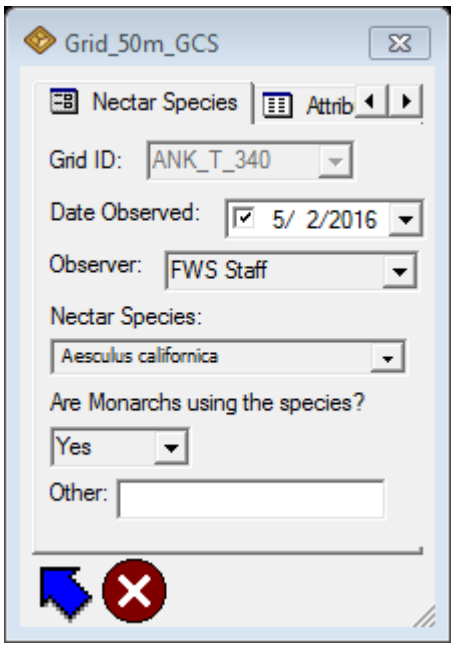
Monarch Behavior Observed: Observed behavior of monarchs at site (multi-select choice). See **Table 8**.

Nectar Species Form*

This form is used to report nectar species observed at the survey site.

Relational table, multiple records may be entered for a single cell. When the tab is selected the attribute table is displayed showing all records for the selected feature (grid cell).





Date Observed: Date of observation

Observer: Other Agency, CitizenScientist, FWS Volunteer, FWS Staff, FWS Biotech (choose one).

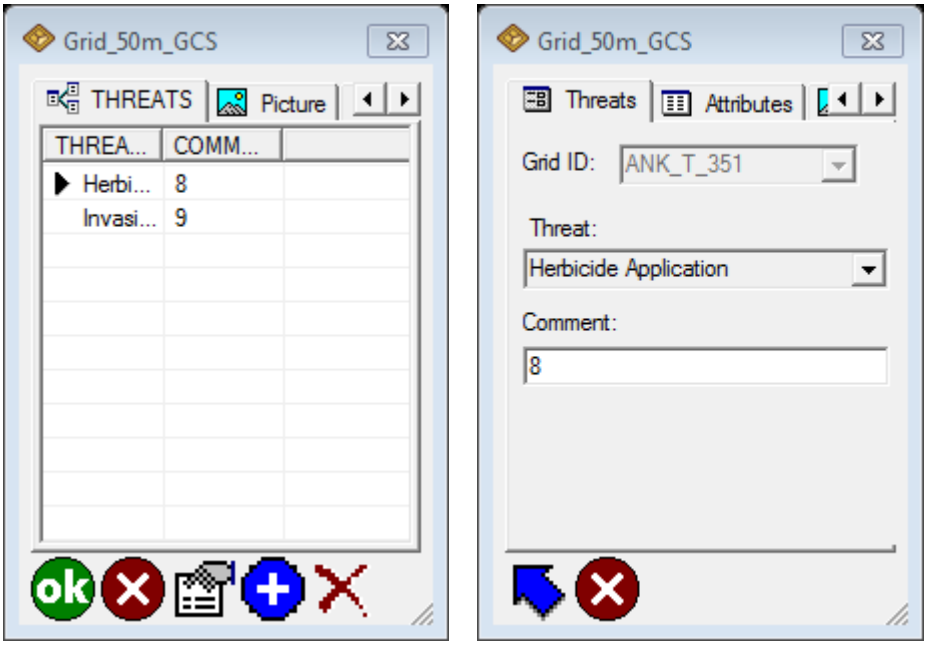
Nectar Species: Enter the genus and/or species of nectar plant that monarch is using, if genus/species is known. See **Table 9** for list of nectar plants.

Are Monarchs using the species?: Were monarchs observed using the species? Yes or No (choose one).

Other: Use the open text field to note any species that may not be included in the standard dropdown (Nectar Species)

Threats Form

This form is used to report threats at the observation site.



Threat: Known or potential issues that may threaten the persistence of a population (multi-select). See **Table 10** for list of threats.

Comment: Enter any comments regarding threats to monarchs and/or milkweed at the observation site.

ArcPad Navigation Aids

Survey Sites and Transects Layers

Included in the field ArcPad map project are the survey sites and transects layers. These features can be selected from the map viewer and used for assisted navigation. They can also be labelled, on the fly, on the field unit.

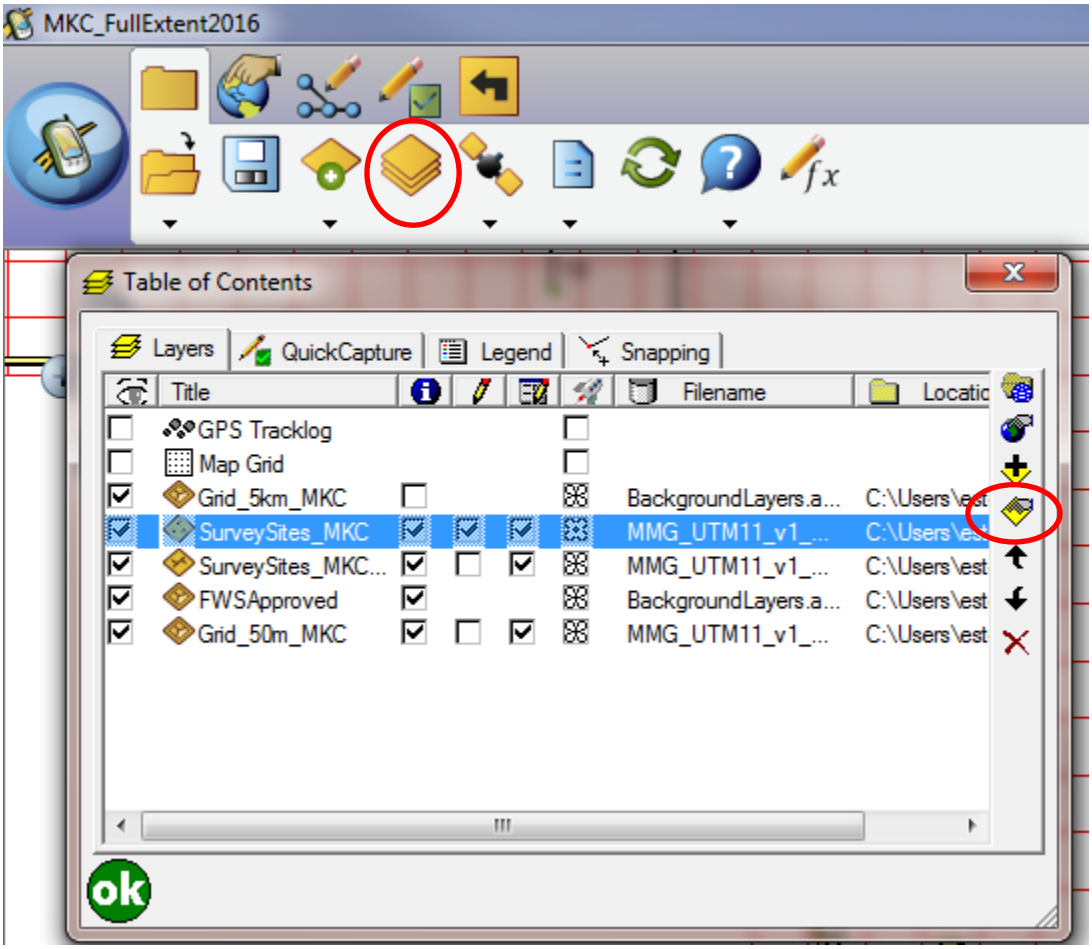
The survey sites and transects layers contain all the valuable information about the Sample plot order, Block and Plot associations. A projected and unprojected set of coordinates are also available.

Labelling Features within ArcPad

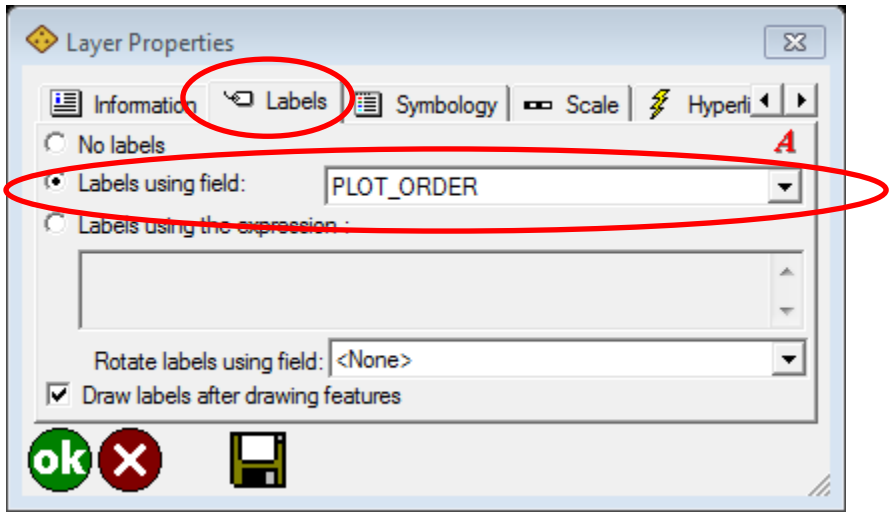
Layers checked out from ArcMap can be labelled on the fly using ArcPad. This is very useful for reviewing and selecting sample sites for surveying.

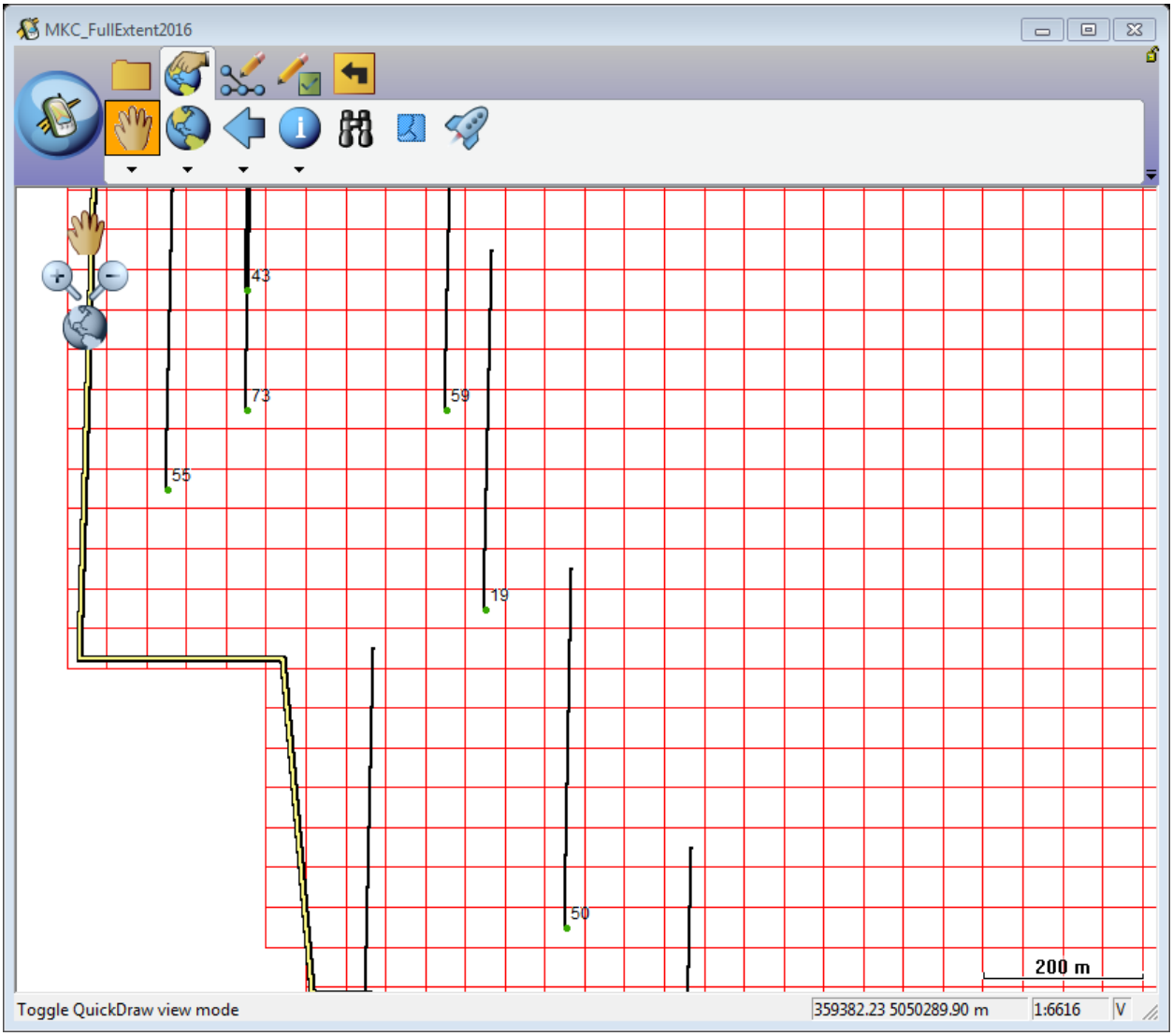
Go to the main screen. Select the layers icon. A window will open that can be used to control the functionality of each layer. There are many options here such as limiting which layers can utilize the identify window. Also limiting which layers are editable.

To access the symbology and labelling options, select the layer you want to set labels, then click the little hand over feature button.



A new window will open, select the Labels tab. Change the radial button to Labels using field: and set the dropdown to PLOT_ORDER. Click OK. Adjust the font size by clicking the red A.

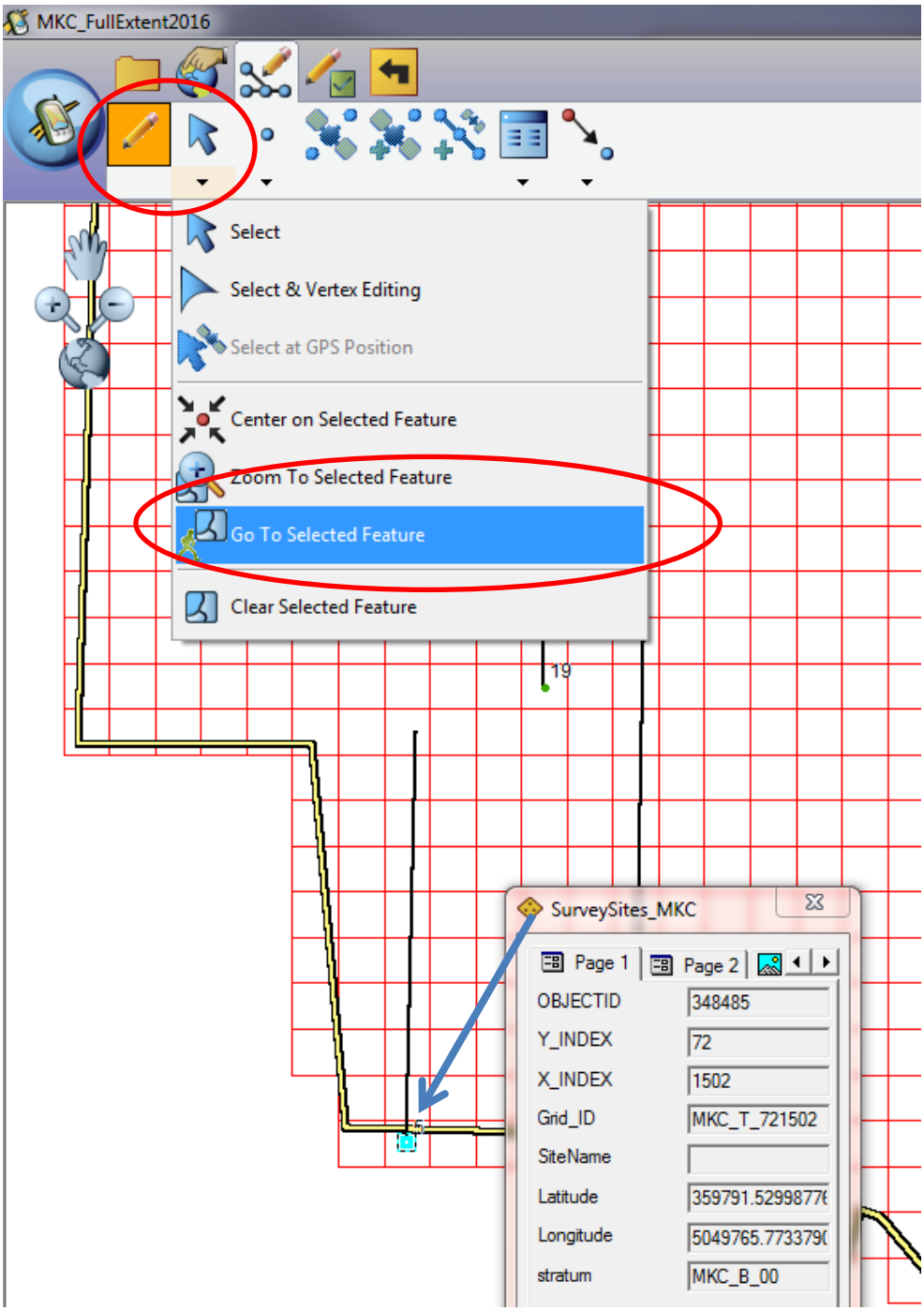



MKC_FullExtent2016
43
73
59
55
19
50
200 m
Toggle QuickDraw view mode
359382.23 5050289.90 m
1:6616
V

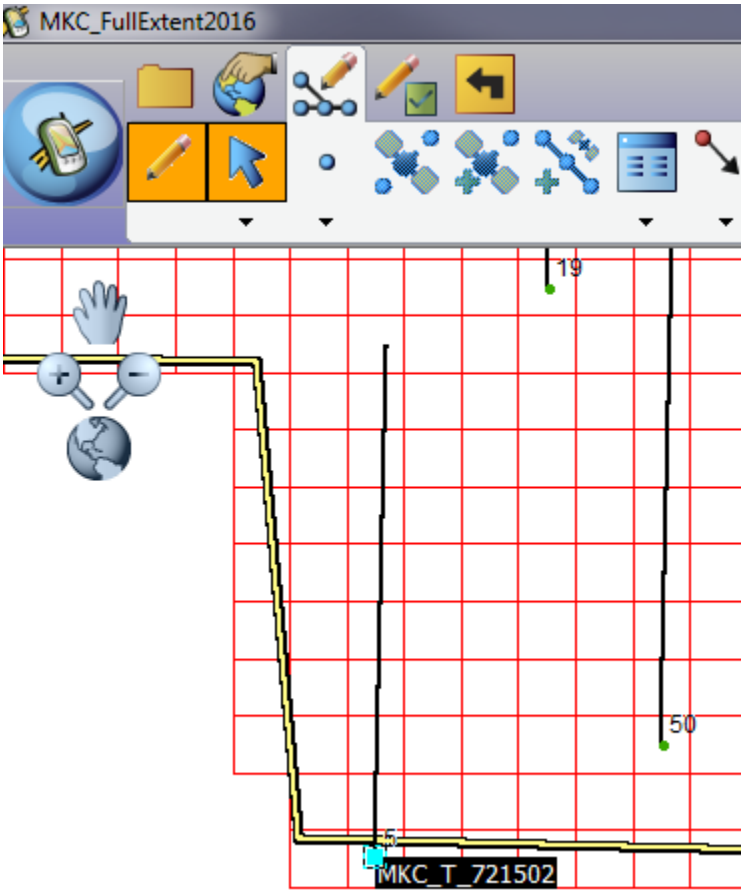
Go To Navigation

Go To Selected Features is a handy way to use the ArcPad map as a way to identifying and navigating to your survey sites. Once you have the labels turned on you can clearly see the plot order of all the available survey sites.

To use this functionality go to the edit menu and turn on the editing for the survey sites layer., Then Select the next site using the select tool. And then click Go to Selected Feature.



The destination is displayed with a Mark label.



Use the GPS Position Window to view the distance (DST) and bearing (BRG) from your current GPS position to your selected destination

Tip

Activating the GPS: It is not necessary to activate the GPS before selecting a navigation destination. However, the GPS does need to be activated in order to open the GPS Position Window and view the distance and bearing to the destination.

Tip

Clearing the selected destination: To clear the selected destination and remove the destination Mark label, tap the Clear Selected Feature located on the drop-down list below the Select menu on the toolbar. The Mark label is displayed when a destination has been selected.

****

Scroll through each of the tabs and fill in the attributes that are appropriate.

Be sure to click the green OK to save.

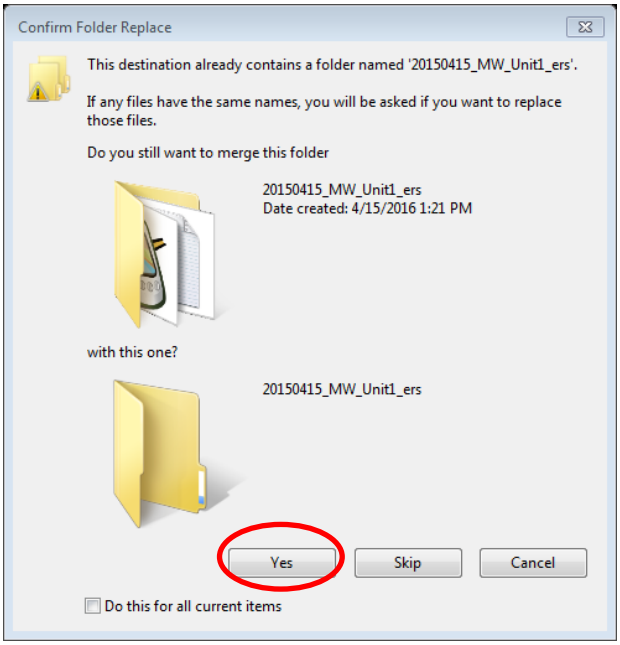
It is always best practice to stop editing after data collection is finished and before exiting the map, and save and close your map on the GPS unit before downloading the data back to your computer.

Check-in Data from GPS to Geodatabase (ArcMap)

Connect your GPS to the computer and let Mobile device center connect.

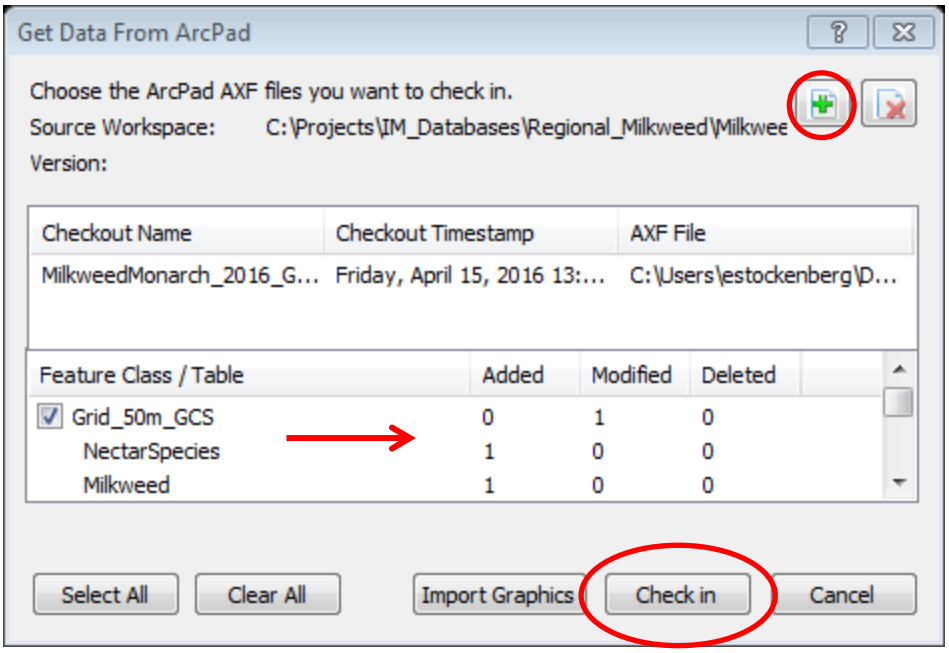
Now the data will be copied from the device to your checkout folder, and you will be replacing the checkout with your edited version. But first, make a backup! Make a copy and stick it into your check-in backup folder before you replace the actual checked out folder.

When you attempt to overwrite the checked out (not edited) folder with your edited version you will receive a warning, click Yes and proceed.

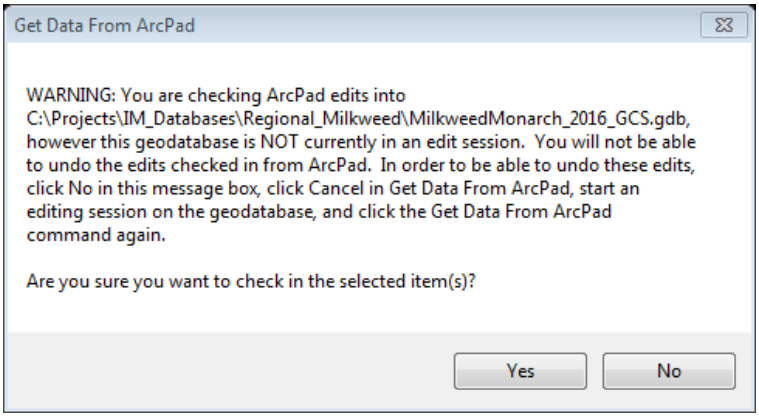


Return to ArcPad Data Manager.

Use the Green plus to navigate to your edited checkout data. Select the axf file. You will then see a summary of how many features and relational table records were added and/or modified. Select the Feature Classes with new or modified data. Click Check in.

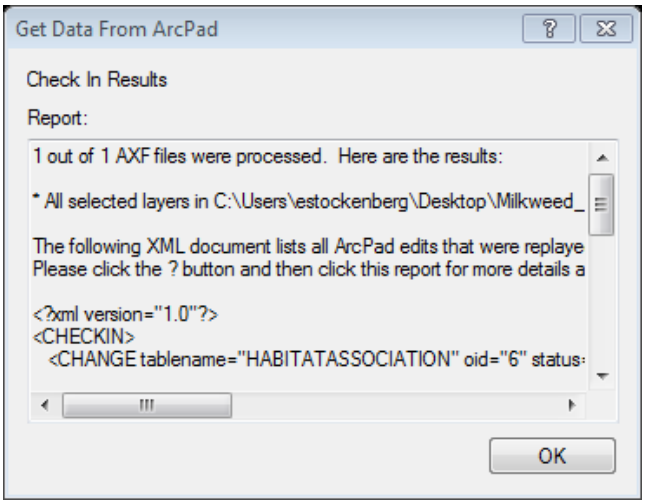


If you do this process outside an edit session you will receive a warning that you cannot undo. If you are worried; Cancel, go into an edit session and return to this point that way you can undo if need be.

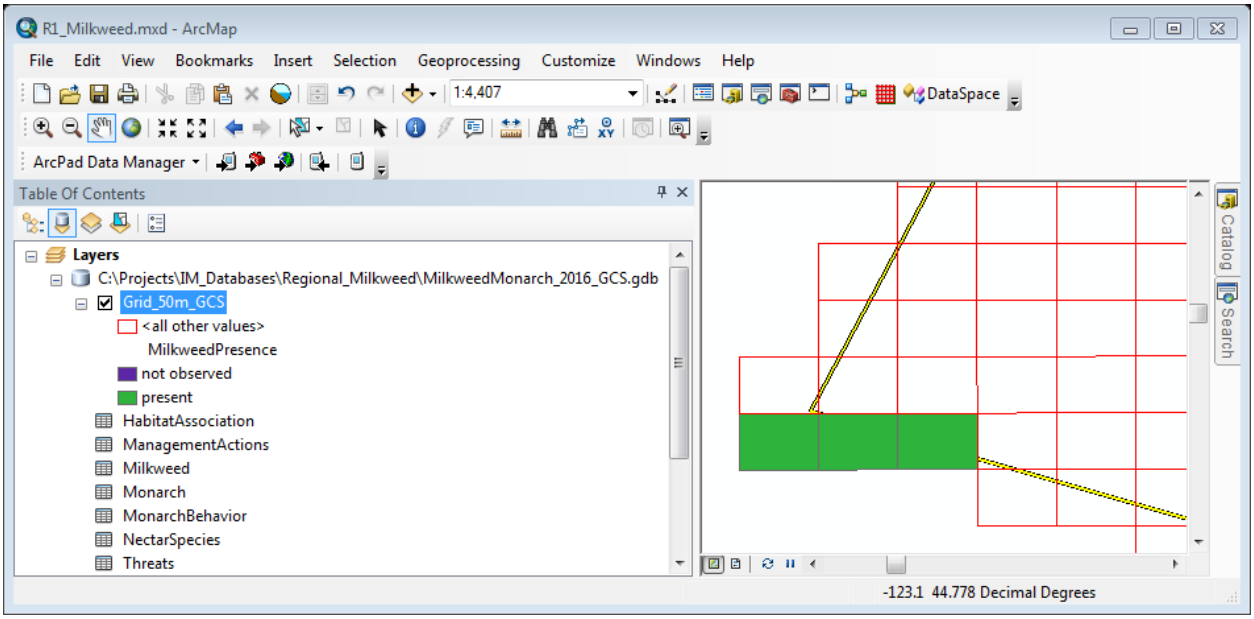


The check-in process may take some time depending on the number of features collected and the size of the extent. Please be patient!

A Results dialog will appear and look to see that your layers were **successfully checked in**.



Click OK. Then Cancel out of the Get Data from ArcPad window. Go look at your data!



Data Definition Tables

Table 1. Habitat Type

Habitat Type	Habitat Description
Cultivated Crops	Areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
Deciduous Forest	Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.
Emergent Herbaceous Wetlands	Areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
Evergreen Forest	Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.
Garden	Garden
Grassland/ Herbaceous	Areas dominated by gramanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.
Mixed Forest	Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.
Park-Open Space	Areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.
Pasture/Hay	Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation.
Shrub/Scrub	Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.
Woody Wetlands	Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled.
Developed-High Intensity	Highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover.

Developed-Medium Intensity	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.
Developed-Low Intensity	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.

Table 2. Habitat Association

Habitat Association	Definition
Edge Habitat	milkweed plants occur within a 5 meter transition zone between 2 habitat types
Floodplain Habitat	milkweed plants occur along shorelines of a waterbody or within the natural floodplain of a river or stream
Fence Row	milkweed occurs predominantly along a fenceline, usually in a linear fashion, and excluded from expansion by management actions or other features
Garden-Park	
Roadside	milkweed plants occur within a roadside right-of-way, usually in a linear fashion, and excluded from expansion by impervious surfaces or other features
Public Utility Corridors	any rights-of-way or facilities managed by a utility company; e.g., under transmission lines, pipelines
Irrigation Canals	open artificial water conveyance systems generally associated with agriculture
Irrigated Agriculture Fields	Fields or crops irrigated for agricultural purposes, usually with sprinkler systems or watered through crop rows
None of the Above Apply	Milkweed plants do not occur in any of the above scenarios

Table 3. Management Actions

Management Actions	Definitions
Grazing	Livestock grazing occurs at least once every 3 years
Intense Mowing	Mowing occurs annually or more frequently
Light Mowing	Mowing occurs, but with at least 1 year of rest between each mowing
Haying	Haying occurs at least once every 3 years
Intense Haying	Haying occurs annually or more frequently;
Prescribed Burning	Prescribed burning occurs at least once every 3 years
Frequent Herbicide Applications	Herbicide applications occur annually or more frequently; may or may not target milkweed
Infrequent Herbicide Applications	Herbicide applications occur every 2 years or less; may or may not target milkweed
Insecticide Applications	Insecticide applications occur at least once every 3 years or more frequently
Timber Harvest	Milkweed plants occur in a designated timber harvest area

Brush Clearing	Understory vegetation is cleared at least once every 3 years for fire suppression or other reasons
Road Grading	Roads and/or road ditches are graded at least once every 3 years
Supplemental Watering	Milkweed plants receive supplemental water directly as part of landscape or nursery operations
Indirect Watering	Milkweed plants receive supplemental water from agricultural runoff, sprinkler systems, roadside ditches, agricultural ponds
Irrigation Ditch Maintenance	Ditch maintenance occurs once every 3 years or less

Table 4. Count Type

Count Type	Definition
Plant	single multi-branched plants
Stem	single, unbranched stems from clonal species

Table 5. Milkweed Species (subspecies)

Code	Milkweed Scientific Name	Code	Milkweed Scientific Name
ASAL	Asclepias albicans	ASLE13	Asclepias lemmonii
ASAN5	Asclepias angustifolia	ASLI6	Asclepias linaria
ASAS	Asclepias asperula	ASMA10	Asclepias macrosperma
ASASA	Asclepias asperula ssp. asperula	ASMA	Asclepias macrotis
ASASC	Asclepias asperula ssp. capricornu	ASNU	Asclepias nummularia
ASBR	Asclepias brachystephana	ASNY	Asclepias nyctaginifolia
ASCA3	Asclepias californica	ASOE	Asclepias oenotheroides
ASCAC3	Asclepias californica ssp. californica	ASOV	Asclepias ovalifolia
ASCAG	Asclepias californica ssp. greenei	ASPU	Asclepias pumila
ASCO	Asclepias cordifolia	ASQU2	Asclepias quinquedentata
ASCR	Asclepias cryptoceras	ASRU6	Asclepias rusbyi
ASCRC2	Asclepias cryptoceras ssp. cryptoceras	ASSO	Asclepias solanoana
ASCRD2	Asclepias cryptoceras ssp. davisii	ASSP	Asclepias speciosa
ASCU	Asclepias curassavica	ASST	Asclepias stenophylla
ASCU9	Asclepias cutleri	ASSU	Asclepias subulata
ASEL	Asclepias elata	ASSU2	Asclepias subverticillata
ASEN	Asclepias engelmanniana	ASSY	Asclepias syriaca
ASER	Asclepias eriocarpa	ASTU	Asclepias tuberosa
ASER2	Asclepias erosa	ASTUI	Asclepias tuberosa ssp. interior
ASFA	Asclepias fascicularis	ASUN4	Asclepias uncialis
ASFR13	Asclepias fruticosa	ASUNR	Asclepias uncialis ssp. ruthiae
ASGL5	Asclepias glaucescens	ASUNU2	Asclepias uncialis uncialis
ASHA6	Asclepias hallii	ASVE	Asclepias verticillata
ASHY5	Asclepias hypoleuca	ASVE2	Asclepias vestita

ASIN	Asclepias incarnata	ASVEP	Asclepias vestita ssp. parishii
ASINI	Asclepias incarnata ssp. incarnata	ASVEV	Asclepias vestita ssp. vestita
ASIN14	Asclepias involucrata	ASVI	Asclepias viridiflora
ASLA	Asclepias labriformis	ASWE3	Asclepias welshii
ASLA4	Asclepias latifolia		

Table 6. Milkweed Structure

Milkweed Structure	Definition
Scattered	Single plants or closely-spaced groups which can be readily delineated by a single GPS point and/or discernable patch size; other milkweeds usually out of view and/or easily mapped separately
Clumped	close to loosely-spaced grouping of plants, much longer than wide, whose spatial extent cannot be readily delineated by a single GPS point or patch size; plants may be continuously or discontinuously distributed; gaps between plants generally less than 50' (15 m); occur along road margins, fence lines, or other discreet habitat edges that limit population expansion in 1 or more directions. Coordinates should be approximately mid-line when feasible
Linear	single plants or closely-spaced groups which cannot be readily delineated by a single GPS point and/or discernable patch size; usually distributed somewhat continuously throughout a habitat or field; plants mainly in sight-distance from each other, without large gaps (>50') that break the continuity of the distribution.

Table 7. Plant Count

Plant Count Method	Definition
Complete plant/stem count	all visible plants or stems were counted within the area designated as the site
Optical Estimation	count and percentages estimated
Standardized Methodology	counts and percentages derived from accepted and documented subsampling methods
Other Methods	

Table 8. Monarch Behavior

Behavior Notes	Definition
Flying (Migrant)	Subjective - monarch flying out of or over the site in a relatively straight direction and altitude that indicates migratory behavior
Flying (Foraging)	Subjective - monarch flying near ground-level, flight path non-directional
Loafing/Perched	Monarch perched on a non-flowering plant or other object during daytime
Night Roosting	Monarch perched in a tree, shrub or other sheltered site, just prior to sunset

Nectaring	Monarch actively nectaring from a flower
Mating	Male and female monarchs clasped together
Egg Laying	Female monarch actively laying eggs
Eclosing	Butterfly is emerging from pupal case
Other	None of the above behavior
None Observed	None observed

Table 9. Nectar Plant List

Species Name	Common Name
Achillea millefolium	Western yarrow
Aesculus californica	California buckeye
Agastache urticifolia	Nettleleaf giant hyssop
Allium acuminatum	Hooker's onion
Allium bolanderi	Bolander's onion
Allium cernuum	Nodding onion
Allium geyeri	Geyer's onion
Allium sanbornii	Sanborn's onion
Allium schoenoprasum	Chives
Allium siskiyouense	Siskiyou onion
Allium spp.	Non-native onion
Anaphalis margaritacea	Pearly everlasting
Apocynum androsaemifolium	Spreading dogbane
Arctostaphylos spp.	Manzanita
Baccharis pilularis	Coyote bush
Centaurea spp.	Introduced knapweeds
Cirsium brevistylum	Short-style thistle
Cirsium douglasii var. breweri	Brewer's thistle
Cirsium edule	Edible thistle
Cirsium occidentale	Cobwebby thistle
Cirsium spp.	Thistles
Cleome lutea	Yellow spiderflower
Columbiadoria (Haplopappus) hallii	Hall's goldenweed
Coreopsis atkinsoniana	Columbia coreopsis
Coreopsis spp.	Coreopsis
Delphinium glaucum	Sierra larkspur
Delphinium spp.	Delphiniums
Dichelostemma capitatum	Bluedicks
Echinacea spp.	Coneflower
Ericameria nauseosa	Rubber rabbitbrush
Eriogonum elatum	Tall woolly buckwheat

Eriogonum spp.	Buckwheat
Eriogonum umbellatum	Sulphur-flower buckwheat
Erysimum arenicola	Cascades wallflower
Erysimum capitatum	Western wallflower
Erysimum menziesii	Pacific wallflower
Erysimum spp.	Non-native wallflower
Eupatorium spp.	Boneset
Helenium autumnale	Common sneezeweed
Helianthus annuus	Common sunflower
Helianthus bolanderi	Bolander's sunflower
Helianthus nuttallii	Nuttall's sunflower
Heterotheca oregona	Oregon false goldenaster
Hosackia crassifolia	Broad leaved lotus
Liatris spp.	Blazing Star
Lobelia spp.	Lobelia
Lythrum salicaria	Purple loosestrife
Monarda spp.	Beebalm
Monardella odoratissima	Mountain monardella
Penstemon procerus	Littleflower penstemon
Penstemon spp.	Penstemon
Philadelphus lewisii	Lewis' mock orange
Prunus virginiana var melanocarpa	Black chokecherry
Pyrrocoma (Haplopappus) racemosa	Racemed goldenweed
Rhododendron macrophyllum	Pacific rhododendron
Rhododendron spp.	Rhododendron
Ribes aureum	Golden current
Rosa spp.	Native rose
Rosa woodsii ssp. ultramontana	Woods' rose
Rudbeckia occidentalis	Western coneflower
Salvia spp.	Salvia - horticultural varieties
Senecio triangularis	Arrowleaf ragwort
Solidago canadensis var. salebrosa	Rough Canada goldenrod
Solidago elongata	West coast goldenrod
Solidago occidentalis	Western goldenrod
Stachys chamisonis	Great hedge-nettle
Stachys mexicana	Mexican hedge-nettle
Symphyotrichum chilense	Pacific aster
Symphyotrichum hendersonii	Lyall aster
Symphyotrichum spp.	Asters
Trifolium spp.	Clovers

Vaccinium spp.	Huckleberry
Verbena lasiostachys	Western verbena
Viburnum edule	Highbush cranberry
Viburnum ellipticum	Western viburnum
Vicia californica	American vetch
Vicia hassei (exigua)	Hasse's vetch
Vicia spp.	Vetch
Wyethia angustifolia	California compassplant

Table 10. Threats

Threats	Definitions
Mowing	Repeated seasonal mowing or mowing during monarch breeding season
Haying	Repeated seasonal haying or haying during the monarch breeding season
Herbicide Application	Application directly on milkweed or in close proximity (<50')
Insecticide Application	Application directly on milkweed or in close proximity (<50')
Grazing	Excessive grazing that causes trampling of plants
Flooding Regimes	Natural floodplain function lost due to dams or other management actions
Vegetation Encroachment	Lack of fire and other natural disturbance regimes that promote vegetation succession
Invasive Species	Presence of invasive grass or shrub species that suppress milkweed growth
Recreational Disturbance	Site subject to off-road vehicle use, foot traffic that can impact plant growth